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Upper GI

A new clinical severity score for the management of acute small bowel obstruction

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Objective: Small bowel obstruction (SBO) is a common hospital admission diagnosis. Identification of patients who will require a surgical resection because of a non-viable small bowel remains a challenge. We aimed to identify risk factors for intestinal resection in patients with SBO and to develop a practical clinical score designed to guide surgical vs. conservative management.
Methods: We performed a prospective cohort study and included all patients admitted for an acute SBO between 2007 and 2016 in our center. Patients were divided in three categories: conservative management, surgical treatment with or without bowel resection. Clinical variables were assessed and compared between groups. Logistic regression models were used to identify the best predictors.
Results: 604 patients were included in this study. 438 (73%) had surgery of which 127 (21%) had small bowel resection. 166 (27%) patients were treated conservatively. Among 13 clinical variables, univariate and multivariate logistic regression models identified 8 variables with a strong association with small bowel resection: age $\geq$70 years, a first episode of SBO, absence of bowel movement for $\geq$3 days, abdominal guarding, C-reactive protein $\geq$50, and 3 signs on abdominal CT-scan, namely, small bowel transition point, lack of small bowel contrast enhancement, and the presence of $>$500 mL of intra-abdominal fluid. Each variable was given one point. We observed that 71-100% of patients with $\geq$4 points required a surgical resection. Sensitivity and specificity of this score were 65% and 88%, respectively and the area under the curve (AUC) was 0.84 (95% CI 0.80-0.89). Additionally, we propose two variants of the 8-tem score: a 7-item score excluding the lack of contrast enhancement, specifically designed for patient with contrast allergies or renal insufficiency, and a simplified 4-item score leaving age, guarding, transition zone on CT-scan, and the presence of 500 mL of fluid on CT scan. Both scores showed similar performances compared to the 8-item score with an AUC of 0.83 and 0.80 for the 7- and 4-item scores, respectively.
Conclusion: We developed a practical clinical severity score designed to tailor management of patients presenting with a SBO. A score of $\geq$4 points indicates the need for surgical exploration given the high likelihood of small bowel ischemia in these patients.

Robot-assisted vs. laparoscopic repair of complete upside-down stomach hiatal hernia (the RATHER-study): A prospective comparative single center study

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Objective: Complete upside-down stomach (cUDS) hernias are a subgroup of large hiatal hernias characterized by high risk of life-threatening complications and technically challenging surgical repair including complex mediastinal dissection. In a prospective, comparative clinical study, we evaluated intra- and postoperative outcomes, quality of life and symptomatic recurrence rates in patients with cUDS undergoing robot-assisted, as compared to standard laparoscopic repair (the RATHER-study).
Methods: All patients with cUDS herniation requiring elective surgery in our institution between July 2015 and June 2019 were evaluated. Patients undergoing primary open surgery or additional associated procedures were not considered. Primary endpoints were intra- and postoperative complications, 30-day morbidity, and mortality. During the 8-53 months follow-up period, patients were contacted by telephone to assess symptoms associated to recurrence, whereas quality of life was evaluated utilizing the Gastroesophageal Reflux Disease–Health-Related Quality of Life (GERD-HRQL) questionnaire.
Results: A total of 55 patients were included. 36 operations were performed with robot-assisted (Rob-G), and 19 with standard laparoscopic (Lap-G) technique. Patients characteristics were similar in both groups. Median operation time was 232 min. (IQR: 145-420) in robot-assisted vs. 163 min. (IQR:112-280) in laparoscopic surgery ($p < 0.001$). Intraoperative complications occurred in 5/36 (12.5%) cases in the Rob-G group and in 5/19 (26%) cases in the Lap-G group ($p = 0.28$). No conversion was necessary in either group. Minor postoperative complications occurred in 13/36 (36%) Rob-G patients and 4/19 (21%) Lap-G patients ($p = 0.36$). Mortality or major complications did not occur in either group. Two asymptomatic recurrences were observed in the Rob-G group only. No patient required revision surgery. Finally, all patients expressed satisfaction for treatment outcome, as indicated by similar GERD-HRQL scores.
Conclusion: While robot-assisted surgery provides additional precision, enhanced visualization, and greater feasibility in cUDS hiatal hernia repair, its clinical outcome is at least equal to that obtained by standard laparoscopic surgery.

Multimodal management of gastroesophageal junction adenocarcinoma: Which type of neoadjuvant treatment?

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Objective: The current treatment for locally advanced gastroesophageal junction (GEJ) adenocarcinoma consists of neoadjuvant treatment (NAT) followed by surgery. Preoperative chemotherapy (CT) and radiochemotherapy (RCT) are both valid options, but comparative data for their efficacy remain scarce. This study aimed to assess the efficacy of RCT and CT to achieve a complete pathologic response (CPR) for locally advanced GEJ adenocarcinoma. Secondary endpoints were R0 resection rates, postoperative complications, long-term survival and recurrence.
Methods: All consecutive patients with locally advanced GEJ adenocarcinoma treated with CT or RCT and oncologic resection from 2009 to 2018 were included. A CPR was defined with the Mandard tumor regression score. Standard statistical tests were used as appropriate. Overall and disease-free survival were compared with the Kaplan Meier method and log-rank test. Multivariate analysis was performed to define independent predictors of CPR, and long-term survival.
Results: Among the 94 patients (84%male, median age 62 years [IQR 9.7]), 67 (71.3%) received preoperative RCT and 27 (28.7%) CT. Patient's characteristics and pretreatment tumor stages were comparable. Surgical approach was thoracoabdominal Lewis resection in 95.5% RCT and 81.5% CT patients ($P = 0.085$). CPR was more frequent in the RCT than the CT group (13.4% vs 7.4%, $P = 0.009$), but R0 resection rates were similar (72.1% vs 66.7%, $P = 0.628$). There was a trend to higher ypN0 stage in the RCT group (55.2% vs 33.3%; $P = 0.057$). Postoperatively, RCT patients presented more cardiovascular complications (35.8% vs 11.1%;

P = 0.017), although overall morbidity was similar (68.6% vs 62.9%, P = 0.988). 5-year overall survival was comparable (61.1% RCT vs 75.7% CT, P = 0.259), as was 5-year disease-free survival (33.5% RCT vs 22.8% CT, P = 0.763). Isolated loco-regional recurrence occurred in 2.9% RCT vs 3.7% CT patients (P = 0.976). NAT type was not an independent predictor for complete pathologic response nor long-term survival in the multivariate analysis. Median follow-up was 30 months [95%CI 21.3-38.8] for all patients.

Conclusion: Patients with locally advanced GEJ adenocarcinoma demonstrated higher rates of CPR after RCT than CT, and a trend to a better lymph node sterilization, although this did not translate in a significant survival benefit or decreased recurrence rate.

Preoperative hiatal hernia in oesophageal adenocarcinoma: An impact on patient outcomes?

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Objective: Uncontrolled gastroesophageal reflux and the often-associated hiatal hernia (HH) are frequently encountered in oesophageal adenocarcinoma patients. Previous data suggest unfavourable long-term oncologic outcomes in the presence of a HH, but the evidence remains scarce. The aim of this study was to assess the potential impact of preoperative HH on histologic response after neoadjuvant treatment (NAT), as well as on overall and disease-free survival.

Methods: All patients operated for an adenocarcinoma of the oesophagus or gastro-oesophageal junction (GOJ) between 2012-2018 were assessed. Baseline endoscopy and CT-scan images were retrospectively reviewed to identify the presence of a clinically significant HH (≥3cm). Response to neoadjuvant treatment (Mandard TRG grade), postoperative outcomes and survival were compared between HH and non-HH patients. Categorical variables were compared with the x2 or Fisher's test, whereas continuous ones with the Mann-Whitney-U test. Survival analyses were performed with the Kaplan-Meier method and log-rank test.

Results: Overall, 101 patients were included (84.1% male, median age 63 years); among them, 33 (32.7%) had a HH ≥ 3cm at diagnosis of oesophageal cancer. There were no significant baseline differences in demographics and tumour stages between the two groups. NAT was used in 80.9% of non-HH versus 81.8% HH patients (P = 0.910), most often chemoradiation (57.3% in non-HH versus 63.6% in HH patients, P = 0.423). Surgical approach and postoperative complication rates were similar in all patients. Good response to NAT (TRG 1-2) was observed in 32.3% of non-HH, versus 33.3% of HH patients (P = 0.297), whereas R0 resection was achieved in 94.1% vs 90.9% of patients respectively (P = 0.551). Overall survival was comparable between HH (median 28 mo, 95%CI 22-NA) and non-HH patients (median 41mo, 95% CI 29-NA) (P = 0.605). Disease-free survival was also similar (median 18 mo, 95%CI 12-NA for HH, vs 34mo, 95%CI 14-NA for non-HH patients, P = 0.283), although HH patients experienced higher rates of distant (51.6% vs 29.2% for non-HH, P = 0.033), but not locoregional recurrence.

Conclusion: A clinically significant HH is encountered in almost a third of patients with oesophageal adenocarcinoma. However, in our study, it was not associated with a worse response to NAT, nor did it lead to a worse overall and disease-free survival.

RefluxStopTM, a novel device to address gastroesophageal reflux disease: Short-term results

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Objective: To report safety, feasibility, and patient's functional short-term outcome of novel RefluxStop anti reflux operation.

Methods: All patients (n = 20) who received laparoscopic implantation of the RefluxStop device from September 2018 to November 2020 in a university hospital were included for retrospective analysis.

Incidence of adverse device-effects and procedure-related adverse events are reported as safety endpoints.

Feasibility was assessed reporting operation duration, rate of conversion to open surgery and technically correct position of the device by control radiography during patient's follow up. Subjective (Gastroesophageal Reflux Disease - Health Related Quality of Life (GERD-HRQL) - questionnaires; after 6 weeks and every six-month thereof) and objective data (24h-pH-manometry, barium swallows and upper endoscopies) are reported as functional outcome parameters. Comparison between values at baseline versus post-procedure follow-up are performed using the paired samples T-test, if appropriate.

Results: Median follow up was 4 (1 – 22) month. Three out of 20 patients had previous upper gastrointestinal surgery (EndoStim implantation). No serious adverse device related events occurred. One patient with dysphagia required balloon dilatation at the oesophageal gastric junction 4 weeks postoperatively.

Median duration of surgery was 85 (59-188) minutes. There was no conversion to open surgery. There was significant reduction in the mean of total GERD-HRQL score at baseline compared to 6-weeks after surgery with 23.9 and 4.3 ($p < 0.001$) as well as at baseline and 6 month after surgery with 28.4 and 6.8 ($p = 0.021$), respectively. At 6 weeks follow up, all of the subjects had over 50% improvement of the GERD-HRQL score compared to baseline. One patient with acceptable device positioning developed symptom recurrence and received conversion to laparoscopic Toupet fundoplication after 10 months.

Conclusion: RefluxStop procedure seems to be a safe operation with promising short-term results. For high-level recommendation, further studies looking for long-term results and randomized comparisons to the standard anti reflux procedures like Nissen or Toupet fundoplication are required.

Comparison of robotic-assisted and open Ivor Lewis esophagectomies in 321 patients of a single center: A case-matched analysis

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Objective: We introduced robotic-assisted Ivor Lewis esophagectomies (rob-E) using the da Vinci Xi in Oct. 2015. Prior to that, esophagectomies were performed as open Ivor Lewis (open-E) procedures. Aim of this study is to evaluate the safety of rob-E in comparison to open-E procedures regarding perioperative outcomes.

Methods: Retrospective analysis of prospectively collected data between Feb. 1999 and Dec. 2020. A case-matched analysis, matching open-E to rob-E in a 1:1 manner, was conducted. Cases were matched regarding age, gender, American Society of Anesthesiologists (ASA) score, histological type of tumor, tumor location and stage.

Results: In the study period 321 patients underwent an esophagectomy. 76 received rob-E and 245 open-E. After matching the cases the comparison of preoperative patient and tumor characteristics revealed no differences between the rob-E and open-E group regarding age at time of operation with a median of 69.5 (35-83) respectively 70 (46-88) years ($p = 0.900$), gender with 84.2% male in both groups ($p = 1.000$), ASA score with 68.4% ASA 3 or 4 in both groups ($p = 1.000$), percentage of tumor stage III of 53.9% respectively 57.9% ($p = 0.707$), and rate of neoadjuvant treatment of 82.9% in rob-E and 81.6% in open-E ($p = 1.000$). Conversion from rob-E to open-E was never necessary. For rob-E versus open-E no difference was found regarding overall morbidity with 69.7% versus 60.5% ($p = 0.307$), major morbidity (Clavien-Dindo >= 3b) with 11.8% versus 14.5% ($p = 0.811$), incidence of anastomotic insufficiency with 7.9% versus 5.3% ($p = 0.745$), rate of surgical reintervention with 5.3% versus 7.9% ($p = 0.745$), and mortality with 2.6% versus 3.9% ($p = 1.000$). Postoperative details showed no difference including a similar duration of hospitalization with a median of 20 (13-62) respectively 18.5 (13-52) days ($p = 0.368$) and number of harvested lymph nodes with a median of 24.5 (7-59) in rob-E and 23 (2-64) in open-E ($p = 0.203$).

Conclusion: The introduction of rob-E in our institution was safe, as perioperative morbidity and mortality did not differ from the previously performed open-E. Overall, the incidence of major morbidity and anastomotic insufficiency in rob-E and open-E show a satisfactory rate compared to previous reports in literature. Further studies with a larger cohort of rob-E are planned in order to draw more decisive conclusions.

Continuously sutured versus linear-stapled anastomosis in 76 robotic-assisted Ivor Lewis esophagectomies

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Objective: We introduced robotic-assisted Ivor Lewis esophagectomies (rob-E) using the da Vinci Xi in Oct. 2015. Two anastomotic techniques have been performed – continuously sutured (COSU) and linear-stapled (LIST). Aim of this study is to evaluate the two anastomotic techniques regarding perioperative outcomes in our experience.
Methods: Retrospective analysis of prospectively collected data between Oct. 2015 and Dec. 2020 including 76 patients. 45 underwent COSU and 31 LIST. Techniques are demonstrated with video material. Minor (Clavien-Dindo $<=$ 3a) and major (Clavien-Dindo $>=$ 3b) morbidity, rate of anastomotic insufficiency, mortality, and duration of hospitalization were compared.
Results: Patient characteristics were as follows: median age of 69 (35-83) years in COSU and 70 (36-83) years in LIST ($p=0.575$), male gender in 84.4% of COSU and 83.9% of LIST ($p=1.000$), and physical status with American Society of Anesthesiologists score 3 in 62.2% of COSU and 67.7% of LIST ($p=0.771$). Concerning tumor characteristics there were 91.1% adenocarcinomas in COSU and 96.8% in LIST ($p=0.642$), whereas the others were squamous cell carcinomas and one neuroendocrine tumor in COSU. The tumors were stage II in 22.2% respectively 32.3% and stage III in 57.8% respectively 48.4% of COSU and LIST ($p=0.555$). Comparison of minor morbidity occurring in 60.0% of COSU and 54.8% of LIST ($p=0.813$), major morbidity in 8.9% respectively 16.1% ($p=0.473$), incidence of anastomotic insufficiency in 8.9% of COSU and 6.5% of LIST ($p=1.000$), rate of surgical reintervention necessary in 2.2% respectively 9.7% ($p=0.298$) as well as mortality of 2.2% in COSU and 3.2% in LIST ($p=1.000$) showed no difference. Median duration of hospitalization of 20 (13-49) days in COSU and 20 (14-62) in LIST ($p=0.423$) did not differ.
Conclusion: In rob-E COSU and LIST show comparable results and a preferable technique cannot be determined yet. Our results do not support the results of previous reports (Cerfolio et al.) that demonstrated a superiority of LIST. While stapling the backside of the anastomosis in LIST impresses as an elegant way to overcome the surgical demanding part of the anastomosis, other disadvantages such as compromising perfusion of the gastric conduit may prevail and limit the benefits. Further studies with a larger cohort are planned in order to draw more decisive conclusions.

Lower GI

Pudendal nerve block in hemorrhoid surgery: A systematic review and meta-analysis

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Objective: Postoperative pain represents an important issue in traditional hemorrhoidectomy. Optimal pain control is mandatory, in particular in a surgical day care setting.
The aim of this study was to investigate the use of pudendal nerve block (PNB) in patients undergoing hemorrhoidectomy.
Methods: PubMed, Google Scholar, Cochrane Library and Web of Science databases were searched up to December 2020. Randomized trials evaluating the PNB use on postoperative outcomes in patients undergoing hemorrhoidectomy were selected. Opioid consumption, pain on the visual analogue scale, length of hospital stay and readmission rate were the main outcomes of interest and were plotted by using a random-effect model.
Results: The literature search revealed 749 articles, of which 14 with were deemed eligible. A total of 1,214 patients was included, of whom 565 received the PNB and 649 did not. After hemorrhoidectomy, patients in the PNB group received opioids less frequently (RR 0.364, 95%CI 0.292 to 0.454, $p<0.001$) and in a lower cumulative dose (SMD -0.935, 95%CI -1.280 to -0.591, $p<0.001$). Patients receiving PNB experienced less pain at 24 hours (SMD -1.862, 95%CI -2.495 to -1.228, $p<0.001$), had a shorter length of hospital stay (SMD -0.742, 95%CI -1.145 to -0.338, $p<0.001$) and a lower readmission rate (RR 0.239, 95%CI 0.062 to 0.916, $p=0.037$). Sensitivity analysis excluded the occurrence of publication bias on the primary endpoint and the overall evidence quality was judged "high".
Conclusion: This systematic review and meta-analysis shows significant advantages of the PNB use. A reduction in opioid consumption, postoperative pain, complications and length of stay can be demonstrated. Despite limitations, PNB in patients undergoing hemorrhoidectomy should be taken into account.

Long-term outcome of surgery for perianal Crohn's fistula

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Objective: Perianal fistulizing disease is a problem in patients with Crohn's disease (CD) because they often need repetitive surgeries. Among the various available procedures, none of them proves to be superior. In addition, the long-term outcome of fistula Seton drainage is not well described. The aims of this study were to analyze the long-term healing and recurrence rates of perianal fistulas in CD patients, stratified according to the first procedure performed.
Methods: Database analysis of a prospective Swiss cohort of patients with perianal CD.
Results: 365 patients with 576 interventions and a median follow-up of 7.5 years (0 - 12.6) were analyzed. 39.7% of patients required more than one surgery. The first surgical interventions were fistulectomies (58.4%), Seton drainage (26.9%), fistula plugs (2.2%) and combined procedures (9.9%). Fistulectomy patients required no more surgery in 67.6%, one additional surgery in 25.4% and more than one additional surgery in 7.7%. In these 3 groups of patients, after a median follow-up of 12.1 years, perianal fistula closure was achieved in 77.1%, 74.1% and 66.7%, respectively. In patients with Seton drainage as index surgery, 50.3% required no more surgery and over 75% achieved fistula closure after 10 years. 49.7% of patients with Seton required one or more surgeries. At median follow up of 7.5 years, closure rates were 64.2% and 60.5% in patients with one and more than one surgeries, respectively. There was no difference in demographics in Seton patients with closed or not closed fistulas. Non-closure patients had a higher Crohn Disease Activity Index (33 vs. 6) and more frequent anti-TNF medication (57.4% vs. 48.1%).
Conclusion: First line fistulectomies achieved the highest healing rates in perianal CD but 1/3 of patients require additional surgeries and 1/4 patients will remain with a fistula at 10 years. Initial seton drainage and concurrent medical therapy can achieve fistula closure in 75%. However, in 50% of patients more surgeries are performed with a seton staying in place up to 5 years and fistula closure in only 2/3 patients.

Rate of local recurrence in a cohort of 125 patients treated by transanal total mesorectal excision due to rectal cancer

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Objective: Transanal total mesorectal excision (taTME) is an alternative to conventional TME owing to its reported superior ability to achieve

clear resection margins in low rectal cancers. Yet, nationwide Norwegian data claimed a 12-month local recurrence rate of up to 10%, a three-fold increase compared to conventional TME, questioning the oncological safety of taTME.

Methods: Consecutive patients with low rectal cancer treated by taTME were prospectively included. Patients who required a partial mesorectal excision were excluded. Perioperative outcomes were reported as median and interquartile range (IQR). Data were independently audited and certified.

Results: 125 patients (88 men : 37 women) with a low rectal cancer (7 cm to anal verge, IQR 5-9) underwent a taTME. Age and body mass index were 65 years (IQR 56-76) and 26 kg/m2 (IQR 23-29). 87 (70%) patients had neoadjuvant radiochemotherapy. Surgery time was 357 minutes (IQR 303-435), including an ileostomy in all patients. 1 patient (0.8%) required a conversion to laparotomy. Performing taTME in a 2-team technique saved 94 minutes or 19% operating time ($p < 0.005$, t-test one-team ($n = 52$, 420 minutes, IQR 349-494) vs. 2-team ($n = 73$, 326 minutes, IQR 285-372). 30-day morbidity amounted to 36% minor complications (Dindo Clavien I-II) and 25% major complications (Dindo Clavien III-V), including 11 anastomotic leaks (9%) and 3 reoperations (3%). Most of the leaks could be managed endoscopically and the ileostomy reversed at last. Median length of hospital stay was 10 days (IQR 8-14).

Median follow-up was 45 months (IQR 25-67; range 13-95). Dissection of the mesorectum was excellent (Quirke 1 incomplete mesorectal excision rate: 1.6%) with 100% clear margins (distal margin 16mm, IQR 10-30; circumferential margin 10mm, IQR 5-15). Median T stage was 3 (IQR 2-3). 24 patients had positive lymphnodes (median 27, IQR 21-38). Local recurrence occurred in 7 (6%) patients and development of metachronous metastasis was present in 36 (29%) patients. This led to a 5-year disease-free survival of 56% and a 5-year overall survival of 86%.

Conclusion: Transanal total mesorectal excision allows good surgical and oncologic quality to the expenses of a reasonable surgery time and morbidity.

Opioid free pain management in ambulatory hemorrhoidectomy reduces pain

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Objective: Outpatient hemorrhoid surgery is a topic of growing importance with a need of modifications to pain management to enable early discharge. Opioid free anesthesia and analgesia (OFAA) has the goal to reduce postoperative pain as well as to improve discharge circumstances. The impact of OFAA on patients receiving ambulatory hemorrhoidectomy is investigated.

Methods: A retrospective cohort study on ambulatory hemorrhoidectomy between 2018 and 2020 was performed and patients that did and did not receive OFAA were compared. In the OFAA group patients received spinal anesthesia with Takipril and hyperbaric technique. Additionally Metamizole 500mg i.v. and Paracetamol 1g i.v. was used. In the non-OFAA group opioids were administered intravenously (fentanyl or remifentanyl) and sublingual (buprenorphin). Primary endpoint was pain measured according to a numeric rating scale (NRS) one hour postoperatively. Secondary endpoints were pain 24 hours postoperative, duration of hospital stay, urinary retention, postoperative nausea and vomiting (PONV), overall morbidity, and re-admission. Wilcoxon Rank-Sum test was performed to search for differences between the outcomes.

Results: 117 patients were included in the analysis. 41 percent of the patients were female. The mean age was 54±14 years. 40 patients did not receive opioids perioperatively (OFAA group) and 77 did (non-OFAA group). The non-OFAA group received a mean dose of 23.3±17.9 mg morphine equivalent. Median NRS score one hour postoperatively was 0 (interquartile range 0-1) for OFAA and 2 (0-4) for non-OFAA ($p = 0.01$). The median NRS score 24 hours postoperatively was 1 (0-2) for OFAA and 1 (0-3) for non-OFAA ($p = 0.40$). There were 3 patients (7.5%) with urinary retention in OFAA and 5 patients (6.5%) in non-OFAA($p = 0.84$).No patient had PONV in OFAA and 5 (6.5%) in non-OFAA ($p = 0.10$). The overall morbidity was 5 (12.5%) in OFAA and 16 (20.8%) in non-OFAA ($p = 0.27$). There were two readmissions (5%) in OFAA and 6 (7.8%) in non-OFAA ($p = 0.58$).

Conclusion: There is a significant difference in pain one hour postoperatively between OFAA and non-OFAA with a clear benefit of not administering opioids. Opioids may trigger pelvic floor spasms and disimprove postoperative pain. In the context of outpatient surgery, we recommend an opioid free operation to reduce postoperative pain and improve discharge prerequisites.

Pre-operative iron allows correction of anaemia before abdominal surgery: A systematic review and meta-analysis of randomized controlled trials

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Objective: Professional surgical societies recommend the identification and treatment of pre-operative anaemia in patients scheduled for abdominal surgery. However, the evidence supporting this recommendation has been of poor quality until the recent release of several randomized controlled trials (RCT) addressing the question. Our aim was to determine if pre-operative iron allows correction of haemoglobin concentration and decreased incidence of peri-operative blood transfusion in patients undergoing major abdominal surgery.

Methods: MEDLINE, Embase and CENTRAL were searched for RCTs written in English and assessing the effect of pre-operative iron on the incidence of peri-operative allogeneic blood transfusion in patients undergoing major abdominal surgery. Pooled relative risk (RR), risk difference (RD) and mean difference (MD) were obtained using models with random effects. Heterogeneity was assessed using the Q-test and quantified using the I2 value.

Results: Four RCTs were retained for analysis out of 285 eligible articles. MD in haemoglobin concentration between patients with pre-operative iron and patients without pre-operative iron was of 0.81 g/dl (3 RCTs, 95% CI: 0.30 to 1.33, I2: 60%, $p = 0.002$). Pre-operative iron did not lead to reduction in the incidence of peri-operative blood transfusion in terms of RD (4 RCTs, RD: -0.13, 95% CI: -0.27 to 0.01, I2: 65%, $p = 0.07$) or RR (4 RCTs, RR: 0.57, 95% CI: 0.30 to 1.09, I2: 64%, $p = 0.09$).

Conclusion: Pre-operative iron significantly increases haemoglobin concentration by 0.81 g/dl before abdominal surgery but does not reduce the need for peri-operative blood transfusion. Important heterogeneity exists between existing RCTs in terms of populations and interventions. Future trials should target patients suffering from iron-deficiency anaemia and assess the effect of intervention on anaemia-related complications.

Sarcopenia and surgical outcomes in patients undergoing oncologic colonic surgery

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Objective: Sarcopenia is a marker for malnutrition and frailty which could lead to higher complication rate and prolonged length of stay (LOS) after surgery. The study aim was to assess the correlation between sarcopenia and clinical outcomes in oncologic colonic surgery.

Methods: This retrospective study included consecutive patients operated between 2014 and 2019. Three radiological indices of sarcopenia were measured at the level of the third lumbar vertebra on preoperative CT scans: Skeletal Muscle Area (SMA), Skeletal Muscle Radiation Attenuation (SMRA), and Skeletal Muscle Index (SMI). Patients with major complications (> grade 3a) according to Clavien classification were compared to those without. Statistical correlation between sarcopenia

indices, LOS and Comprehensive Complication Index (CCI) was tested by use of the Pearson correlation.
Results: A total of 325 patients were included, 50 (15.4%) with and 275 (84.6%) without major complications. SMA and SMI were comparable between both groups (respectively 126.0 vs 125.2 cm2, $p = 0.974$, and 43.4 vs 44.3 cm2/m2, $p = 0.636$), while SMRA was significantly lower in patients with major complications (33.6 vs 37.3 HU, $p = 0.018$). A lower SMRA was correlated with prolonged LOS ($r = -0.207$, $p < 0.01$) and higher CCI ($r = -0.144$, $p < 0.01$), while the other sarcopenia indices had no influence on surgical outcomes.
Conclusion: Preoperative SMRA or muscle quality appears to be a weak predictor for adverse outcomes after oncologic colectomy.

Quantification of residual pneumoperitoneum after robotic-assisted laparoscopic surgery

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Objective: Laparoscopic surgery improves the postoperative recovery process and relies on CO2 insufflation to establish the operative field. Most residual CO2 is expelled prior to port and incision closure. Computed tomography (CT) is often used to assess an acute abdomen and is highly sensitive in detecting free intra-abdominal air – the hallmark sign of a bowel injury. Yet, the clinical significance of free air in the early postoperative period is confounded by residual CO2 and is not usually due to a visceral injury. The aim of this prospective study was to systematically quantify the residual pneumoperitoneum (RPP) at varying timepoints after robotic-assisted laparoscopic surgery.
Methods: Patients undergoing robot-assisted laparoscopic intervention, both radical prostatectomies and left hemicolectomies, were prospectively enrolled in the study. At the conclusion of each operation, manual abdominal pressure was applied to aid in exsufflation of residual CO2. Very-low-dose CT scans were performed on postoperative days (POD) 3, 5, and 7, with subsequent volumetric quantification of RPP. To investigate potential factors influencing the quantity of RPP, correlation plots were made against BMI, age, operative time, total insufflation volume, intra-abdominal pressure, time to flatus and first bowel movement, pain score, and postoperative analgesic requirement.
Results: Thirty-one patients undergoing robotic assisted laparoscopic prostatectomy were untill now enrolled in the study, of which only one experienced a Clavien-Dindo 2 complication; all others were free of any complications during post-operative assessment period. On POD3, 5, and 7, 97%, 94%, and 68% of patients, respectively, demonstrated RPP. The RPP volumes were noted to be 9.6 mL (IQR = 3.9-31.8; maximum = 247 mL) on POD3, 1.0 mL (0.1-5.1; maximum = 221 mL) on POD5, and 0.08 mL (1-1.2; maximum = 112 mL) on POD7. A significant correlation was only appreciated between RPP volume and BMI; those with higher BMIs had lower initial volumes of RPP on POD3 and exhibited a more rapid decrease in RPP over one week.
Conclusion: One week after robot-assisted laparoscopic operations, a majority of patients will exhibit clinically insignificant RPP, even with volumes as high as 250 mL. Larger patients tend to have smaller residuals of CO2. Our data provide new basic knowledge regarding RPP and may help to interpret postoperative CT-scans.

Mapping of aetiologies and clinical presentation of acute colitis: Results from a prospective cohort study in a tertiary centre

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Objective: Our objective was to describe the aetiologies of acute colitis and to identify patients who require diagnostic endoscopy.
Methods: Patients with symptoms of gastrointestinal infection and colonic inflammation on computed tomography were prospectively included. Those immunosuppressed, with history of colorectal cancer or inflammatory bowel disease (IBD) were excluded. Stools were screened with BD-Max and BioFire FilmArray GI panel. Faecal calprotectin was determined. Patients with negative BD-Max underwent colonoscopy. The study was registered into clinicaltrials.gov (NCT02709213).
Results: One hundred and seventy-nine patients were included. BD-Max was positive in 93 patients (52%) and FilmArray in 108 patients (60.3%). Patients with infectious colitis ($n = 103$, 57.5%) were positive for Campylobacter spp ($n = 57$, 55.3%), Escherichia coli spp ($n = 8$, 7.8%), Clostridium difficile ($n = 23$, 22.3%), Salmonella spp ($n = 9$, 8.7%), viruses ($n = 7$, 6.8%), Shigella spp ($n = 6$, 5.8%), Entamoeba histolytica ($n = 2$, 1.9%) and others ($n = 4$, 3.9%). Eighty-six patients underwent colonoscopy, which was compatible with ischemic colitis in 18 patients (10.1%) and IBD in 4 patients (2.2%). Among patients with negative FilmArray, a faecal calprotectin >625µg/g allowed identifying patients with IBD with an area under ROC curve of 85.1%. Introduction of a diagnostic management algorithm including FilmArray and faecal calprotectin could allow decreasing unnecessary colonoscopies from 82 to 29 (corresponding to a decrease of 64.6%).
Conclusion: Computed tomography-proven colitis was mostly of infectious aetiology. Diagnostic management of patients with acute colitis should include broad molecular testing of the stools and, in patients with a calprotectin concentration >625µg/g, colonoscopy to exclude IBD.

Prehabilitation in patients undergoing colorectal surgery fails to confer reduction in overall morbidity: Results of a single-center, single-blinded, randomized controlled trial

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Objective: Patients undergoing major surgery are prone to a functional decline due to the impairment of muscle, cardiorespiratory and neurological function as a response to surgical stress. Currently, there are solely weak recommendations in the ERAS protocol regarding the role of preoperative physical activity and prehabilitation in patients undergoing colorectal surgery. Studies in heterogenous cohorts showed contradictory results regarding the impact of prehabilitation on the reduction of postoperative complications. This randomized controlled trial assesses the impact of prehabilitation on postoperative complications in patients undergoing colorectal surgery within an ERAS protocol.

Methods: Between July 2016 and June 2019, a single-center, single-blinded , randomized controlled trial designed to test whether physiotherapeutic prehabilitation vs. normal physical activities prior to colorectal surgery may decrease morbidity within a stringent ERAS protocol was carried out. The primary endpoint was postoperative complications assessed by Comprehensive Complications Index (CCI®). Primary and secondary endpoints for both groups were analyzed and compared.
Results: A total of 107 patients (54 in the pERACS and 53 in the control cohort) were included in the study and randomized. Dropout rate was 4.5% (n = 5). Mean age (SD) in the control cohort was 65 (29–86) and 66 (24–90) years in pERACS cohort. The pERACS cohort contained more female patients (40% vs. 55%, p = 0.123) and a higher percentage of colorectal adenocarcinoma (32% vs. 23%, p = 0.384) although not significant. Almost all patients underwent minimally invasive surgery in both cohorts (96% vs 98%, p = 1.000). There was no between-cohort difference in the primary outcome measure 30-day Comprehensive Complications Index (15 [0 – 49] vs. 18 [0 – 43], p = 0.059). Secondary outcome as complications assessed according to Clavien-Dindo, length of hospital stay, reoperation rate and mortality showed no difference between both cohorts.
Conclusion: Routine physiotherapeutic prehabilitation cannot be recommended for patients undergoing colorectal surgery within an ERAS protocol (Grade A recommendation). To eliminate other confounders like geographical difference or difference in surgical technique, further multicenter RCTs are needed.

The effect of mesenteric defect closure on internal hernias and small bowel obstruction in patients undergoing colorectal surgery: A systematic review and meta-analysis

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Objective: Internal hernias (IH) are potentially severe complications after colorectal surgery and may lead to small bowel obstruction (SBO). However, the impact of mesenteric defect closure (MDC) on IH and SBO is currently unclear. The aim of this systematic review and meta-analysis was, therefore, to investigate the effect of MDC on IH and SBO in patients undergoing laparoscopic and open colorectal surgery.
Methods: Ovid Medline, PubMed, and Embase databases were searched. Studies reporting MDC in colorectal surgery were enclosed in the systematic review. Meta-analysis included studies that assessed the effect of MDC vs. non-closure (non-MDC) on IH and SBO. Meta-analysis was performed using a random effect model. Results of individual studies were summarized as ranges. Effect sizes were described as odds ratios (OR) with 95% confidence intervals (CI).
Results: Literature search revealed a total of 344 abstracts. Of these, 16 studies met the inclusion criteria. Included studies comprised a total of 10,068 patients and were published between 2009 and 2019. The incidence of IH and SBO as a composite outcome ranged from 0.0 to 3.5%, whereas the incidence of IH and SBO as single outcomes ranged from 0.0 to 2.7% and 0.0 to 1.7%, respectively. If IH occurred, reoperation was required in 66-100% with additional bowel resections in 20-100% and stoma-formation in 17-50%. The complication rate after reoperations was 25-100% and mortality 0-25%. Meta-analysis including four studies revealed no statistically significant effect of MDC on the composite outcome of IH and SBO (OR 0.25, 95% CI 0.04-1.77) and SBO as a single outcome (three studies, OR 0.48, 95% CI 0.04-5.49). The risk for IH as a single outcome was significantly lower in the MDC group (three studies, OR 0.15, 95% CI 0.02-0.92). Heterogeneity of the studies included was low to moderate for the composite outcome, as well as for IH and SBO as single outcomes (I2 40.3%, 0.0%, and 45.7%, respectively).
Conclusion: In current meta-analysis, MDC was not significantly associated with the composite outcome of IH and SBO in patients undergoing colorectal surgery. However, MDC significantly reduced the risk for IH. Based on these results, the benefit of MDC in colorectal surgery remains unclear and needs to be addressed in further studies.

High expression of CD34 protein in stage IIA rectal cancer is independently associated with better prognosis

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Objective: Colorectal cancer (CRC) remains the third most common cause of death from malignancies, while 30% of all these tumors develop in the rectum. The proximity of the rectum to vital structures, and in some cases the use of neoadjuvant treatment, make the surgical resection of this tumor a great challenge even for highly qualified surgeons. Understanding the mechanisms of rectal cancer (RC) development could lead to new concepts in the approach of diagnosis, prognosis, and eventually treatment of this disease. Despite the fact that TNM classification represents the gold standard tool for the staging of RC, a significant number of studies has recently focused on the association between the tumor microenvironment and RC. CD34 is a transmembrane phosphoglycoprotein expressed on human hematopoietic progenitor and vascular endothelial cells, as well in malignant tissues. It has also been shown to be involved in tumor invasion and angiogenesis. Because of the controversial data , we examined the expression of CD34 protein in RC specimens after stratifying the patients according to their UICC stage.
Methods: In our retrospective study, we included 364 patients with unselected, clinically annotated primary RC specimens. We analyzed a tissue microarray (TMA) of these specimens by immunohistochemistry (IHC) for the expression of CD34 protein by tumor cells.
Results: After stratifying the patients in nodal negative and positive groups, we found that the patients with Stage IIA tumors and high expression of CD34 protein had a favorable 5-year overall survival rate (53%; 95%CI = 40.0 – 65.1%) compared to tumors without expression of CD34 protein (26%; 95%CI = 10.7 – 44.6%, p = 0.003). Univariate and multivariate Hazard Cox regression survival analysis revealed that the combined the expression of CD34 protein was an independent, favorable, prognostic marker for overall survival in the stage IIA RC (HR = 0.39, 95%CI = 0.19 – 0.79; p = 0.009).
Conclusion: Our data show that the expression of CD34 protein represents an independent, favorable, prognostic condition in nodal negative stage IIA RC. Thereby, we provide novel insights into the prognostic role of the tumor microenvironment in RC that might help in the development of novel treatment modalities by its modification.

Prospective surveillance after implementation of a colorectal surgical site infection prevention bundle

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Objective: Surgical site infections (SSI) are the most frequent complications after colorectal surgery. The aim of the present study was to evaluate the impact of a standardized SSI prevention bundle.
Methods: The multimodal, evidence-based care bundle included 9 intraoperative items (antibiotic type, timing and re-dosing, desinfection, induction temperature control >36.5°, glove change, intracavity lavage, wound protection and closure strategy). The bundle was implemented in November 2018 and applied to all consecutive patients undergoing colonic resections. Demographics, surgical specifics and overall compliance to the care bundle were prospectively assessed until October 2020. The primary outcome SSI was defined according to the definition of the Center for Disease Control (CDC) and independently assessed by the National Infection Surveillance Committee (Swissnoso) up to 30 postoperative days. A historical, institutional pre-implementation control group (2012-2017, DOI: 10.1016/j.jhin.2018.09.011) with identical methodology was used for comparison.
Results: In total, 243 patients were included. The control group included 1'263 patients. Both groups were comparable regarding main demographics (age, sex, body mass index, American Society of Anaesthesiologists class) and surgical characteristics (type and

duration of surgery). Overall compliance to the care bundle was 77% (IQR 77-88). Lowest compliance was observed for temperature control (48%), intracavity lavage (59%) and predefined wound closure strategy (74%). Surgical site infections were reported in 54 patients (22.2%) vs. 21.4% in the control group, p = 0.79. Infection rates were comparable throughout the CDC categories: superficial: 11 patients (4.5%) vs. 4.2%, p = 0.82, deep incisional: 9 patients (3.7%) vs. 5.1%, p = 0.34, organ space: 34 (14%) vs. 12.4%, p = 0.48.

Conclusion: Implementation of a standardized surgical care bundle had no impact on SSI rates according to these preliminary results. Improved compliance to individual measures may help to achieve a clinical benefit.

Hepato-Pancreaticobiliary

COVID-19-related abdominal pain is associated with elevated liver transaminases, which could predict poor clinical outcomes

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Objective: Abdominal pain and liver injury have been frequently reported during Coronavirus Disease-2019 (COVID-19). In the setting of a systemic infection these features can induce misleading surgical diagnostics. Our aim was to investigate characteristics of abdominal pain in COVID-19 patients and its association with disease severity and liver injury.

Methods: Data of all COVID-19 hospitalized patients over 16 years old were retrieved from the beginning of the epidemic in Switzerland until end of June 2020. Patients admitted exclusively for other pathologies (including surgical abdominal conditions) and/or recovered from COVID-19, and pregnant women were excluded. Abdominal pain was linked to COVID-19 only after evident alternative diagnostic exclusion. Five times the upper limit of transaminases was considered as liver injury.

Results: Among the 1026 patients who fulfill the inclusion/exclusion criteria, 199 (19.4%) exhibited spontaneous abdominal pain and 165 (16.2%) after abdomen palpation. Systematized abdominal pain was most frequently localized in the epigastric (39.8%) and upper right quadrant (23.7%). Considering baseline ALT levels, 7.14% of patients with epigastric pain had pathological ALT value versus 0.29% of patients without symptoms (p = 0.008). When taking the 30days maximal transaminases value, this reached respectively 16.3% versus 2.7% (p < 0.001) and 20% versus 3.8% (p < 0.001) for respectively AST and ALT. With logistic regression we demonstrated that baseline pathological AST value was associated with hospital mortality and/or admission to intensive/intermediate care unit with an odds ratio of 13.9 (CI 1.5-124.7, p = 0.019).

Conclusion: These results suggest that COVID-19-induced abdominal pain is associated with liver injury which could predict poor evolution of disease.

BILCAP-study: Should patients with resected biliary tract cancer really receive adjuvant chemotherapy with capecitabine?

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Objective: According to the 2019 published ASCO guidelines patients with resected biliary tract cancer should be offered adjuvant capecitabine chemotherapy based solely on the results of the BILCAP trial. Aim of this work is to analyze the quality of the BILCAP trial.

Methods: Design, conduct, statistics and reporting of the study were analyzed according to the Delphi list and the CONSORT checklist. The risk of bias was assessed using the Cochrane Risk of Bias Tool.

Results: Several shortcomings could be identified in the study regarding design, conduct, statistics and reporting. The BILCAP study is a randomized, controlled, multicenter, phase 3 study which was done across 44 specialist hepatopancreatobiliary centres in the UK. Despite the inclusion of high specialized centres, the number of included patients each year for each center is extremely low. In particular, a total of 447 patients were included by 44 centers over a period of 11 years, meaning that less than 1 patient was included in this study every year by each center. However, the analysis was not adjusted for center which was one of the stratification factors. Follow up treatment for patients who had disease recurrence was not recorded. Randomization procedure is not well described. Minimization technique was adopted for stratification but mode of application is poorly reported and the choice of variables not justified. No blinding was present. Extensive power evaluations after adjusting the number of needed events, due to lower event rates than expected, were not done. For the observed HR = 0.81 with 234 events statistical power is only around 37%. 4 out of 9 items of the Delphi list and 6 out of 35 items of the CONSORT checklist were not properly addressed. According to the Cochrane Risk of Bias Tool (RoB 2) the overall risk-of-bias judgment for the outcome overall survival of the BILCAP study was "some concerns". Almost all authors declared to have received funds from pharmaceutical companies, so a conflict of interest cannot be excluded. Additionally, the funding agency for this study (Cancer Research UK and Roche) had an advisory role in design and the first author of the BILCAP study was also involved in the generation of the ASCO guideline.

Conclusion: Based on the results of this study there is not enough evidence for the administration of adjuvant chemotherapy with capecitabine in patients with resected biliary tract cancer.

Does persistent cholecystitis after cholecystostomy increase mortality?

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Objective: Numerous publications describe percutaneous cholecystostomy (PC) as a possible treatment option for acute cholecystitis (AC) in selected cases where laparoscopic or open cholecystectomy (CHE) is not feasible due to limited health conditions. Whereas certain experts propose PC as a definitive therapy option for AC, a number of studies question the use of PC, due to high complication rates, no additional benefit of PC compared to CHE, and an increased mortality. The aim of our study was to retrospectively analyze the outcome of patients treated with PC over an extended period of time.

Methods: We conducted a retrospective study of patients who underwent PC for AC at a tertiary referral hospital during the last 10 years. The collected data included basic demographics, details about PC procedure, outcome, surgical-rate and final histologic diagnosis.

Results: Out of 158 patients (median age 75 years) treated with PC for AC, 47 (30%) died without undergoing subsequent CHE. Half of the PC patients (79) underwent subsequent CHE (8% in the hot phase), with

97% of these patients undergoing subsequent CHE within one year after PC. Seven (5%) of them died within the first year. The overall Charlson Comorbidity Index (CCI) was 6.4 (CHE vs. no CHE 5.3 vs. 7.4). Histologically, 22 (29%) of the 75 analyzed specimens showed chronic cholecystitis (CC), and 57 patients (68%) had signs of an AC. In 48 patients (30%), a complication after PC occurred.

Conclusion: In our collective, the 1-year survival after PC was 72%. The majority of these patients were in limited health conditions with a mean pre-PC CCI > 5, which implies a potential one-year mortality rate of over 85%. Histologic examination of almost all cholecystectomy specimens showed persistent inflammation. To our knowledge, this is the first extensive report of histologic findings in gallbladder specimens after PC.

Based on our findings, especially in view of the high mortality rate of PC patients, we propose CHE as the treatment of choice in AC, even in chronically ill and elderly patients after stabilization, e.g. with a PC. PC represents no definitive treatment for AC and should remain a short-term solution because of the persistent inflammatory focus. Because CHE in a critically ill patient can be challenging, it should be performed by the most experienced surgeons.

Incidence of hepatocellular carcinoma in patients with non-alcoholic fatty liver disease: A meta-analysis and meta-regression

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Objective: Nonalcoholic fatty liver disease (NAFLD) may be a risk factor for hepatocellular carcinoma (HCC), but the extent of this association still needs to be addressed. Pooled-incidence rates of HCC across the disease spectrum of NAFLD have never been estimated by meta-analysis.

Methods: In this systematic review, we searched Web of Science, Embase, Pubmed, and the Cochrane library from January 1st, 1950 through July 30th, 2020. We included studies reporting on HCC incidence in patients with NAFLD. The main outcomes were pooled HCC incidences in patients with NAFLD at distinct severity stages. Summary estimates were calculated with random-effects models. Sensitivity analyses and meta-regression analyses were carried out to address heterogeneity. The protocol for this review was registered in Prospero (CRD42018092861).

Results: Eighteen studies, with a total of 470,404 patients were included. In patients with NAFLD at a stage earlier than liver cirrhosis, HCC incidence was of 0.03 per 100 person-years (PYs) (95% confidence interval 0.01-0.07, I2=98%). This rate rose to 3.78 per 100PYs (2.47-5.78, I2=93%) when considering studies that only included patients with liver cirrhosis. Among the latter patients, those undergoing regular HCC screening displayed an incidence of 4.62 per 100PYs (2.77-7.72, I2=77%).

Conclusion: Patients with NAFLD-related liver cirrhosis have a risk of developing HCC similar to that reported for patients with cirrhosis from other etiologies. Evidence documenting the risk in patients with NASH or simple steatosis is limited, but HCC incidence in these populations may lie below thresholds used to recommend HCC screening. Well-designed prospective studies in these subsets of patients are needed.

Shorter survival after liver pedicle clamping in patients undergoing liver resection for hepatocellular carcinoma revealed by a systematic review and meta-analysis

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Objective: Liver pedicle clamping minimizes surgical bleeding during hepatectomy. However, by inducing ischemia-reperfusion injury to the remnant liver, pedicle clamping may be associated with tumor recurrence in the regenerating liver. Hepatocellular carcinoma (HCC) having a high rate of recurrence, evidences demonstrating an eventual association with pedicle clamping is strongly needed.

Methods: We did a systematic review of the literature until April 2020, looking at studies reporting the impact of liver pedicle clamping on long-term outcomes in patients undergoing liver resection for HCC. Primary and secondary outcomes were overall survival (OS) and disease-free survival, respectively.

Results: Results were obtained by random-effect meta-analysis and expressed as standardized mean difference (SMD). Eleven studies were included, accounting for 8087 patients. Results of seven studies were pooled in a meta-analysis. Findings indicated that, as compared to control patients who did not receive liver pedicle clamping, those who did had a significantly shorter OS (SMD = -0.172, 95%CI: -0.298 to -0.047, p = 0.007, I2=76.8%) and higher tumor recurrence rates (odds ratio 1.36 1.01 to 1.83. p = 0.044, I2=50.7%).

Conclusion: This meta-analysis suggests that liver pedicle clamping may have a deleterious impact on long-term outcomes. An individual patient-data meta-analysis of randomized trials evaluating liver pedicle clamping is urgently needed.

Parenchymal-sparing hepatectomy for colorectal liver metastases reduces postoperative morbidity while maintaining equivalent oncologic outcomes compared to non-parenchymal-sparing resection

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Objective: Modern chemotherapy and repeat hepatectomy allow to tailor the surgical strategies for the treatment of colorectal liver metastases (CRLM). This study addresses the hypothesis that parenchymal-sparing hepatectomy reduces postoperative complications while ensuring similar oncologic outcomes compared to the standardized non-parenchymal-sparing procedures.

Methods: Clinicopathological data of patients who underwent liver resection for CRLM between 2012 and 2019 at a major hepatobiliary center in Switzerland were assessed. Patients were stratified according to the tumor burden score [TBS^2 = (maximum tumor diameter in cm)^2 + (number of lesions)^2)] and were dichotomized in a lower and a higher tumor burden cohort according to the median TBS. Postoperative outcomes, overall survival (OS) and disease-free survival (DFS) of patients following parenchymal-sparing resection (PSR) for CRLM were compared with those of patients undergoing non-PSR.

Results: During the study period, 153 patients underwent liver resection for CRLM with curative intent. PSR was performed in 79 patients with TBS < 4.5, and in 42 patients with TBS ≥ 4.5. In patients with lower tumor burden (TBS < 4.5), PSR was associated with lower complication rate (15.2% vs. 46.2%, p = 0.009), and shorter length of hospital stay (5 vs. 9 days, p = 0.006) in comparison to non-PSR. For TBS < 4.5, PSR resulted in equivalent 5-year OS (48% vs. 39%, p = 0.479) and equivalent 5-year DFS rates (DFS, 44% vs. 29%, p = 0.184) compared to non-PSR. For TBS ≥ 4.5, PSR resulted in lower postoperative complication rate (33.3% vs. 63.2%, p = 0.031), lower length of hospital stay (6 vs. 9 days, p = 0.005), equivalent 5-year OS (29% vs. 22%, p = 0.314), and equivalent 5-year DFS rates (29% vs. 22%, p = 0.896) compared to non-PSR. Among all patients treated with PSR, patients undergoing minimal-invasive hepatectomy had equivalent 5-year OS (42% vs. 37%, p = 0.261) and equivalent 5-year DFS (34% vs. 34%, p = 0.613) rates compared to patients undergoing open hepatectomy.

Conclusion: PSR for CRLM is associated with lower postoperative morbidity, shorter length of hospital stay, and equivalent oncologic outcomes compared to non-PSR independently from tumor burden. Our findings suggest that minimal-invasive PSR should be considered as the preferred method for the treatment of curatively resectable CRLM if allowed by tumor size and location.

Endoscopic ultrasound-guided hepaticogastrostomy vs. ERCP for preoperative biliary drainage in patients undergoing pancreatic resection

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Objective: Preoperative bile drainage in patients with obstructive jaundice due to pancreatic head malignancy is needed, if pancreatic head resection cannot be performed in a timely fashion. The safety and efficacy of ultrasound-guided hepaticogastrostomy (HGS) as an alternative to the established endoscopic retrograde cholangio-pancreatography (ERCP) with stent placement needs further investigation.
Methods: Clinicopathological data of patients who underwent partial or total pancreaticoduodenectomy between January 2017 and December 2019 in a major swiss hepatopancreatobiliary center were assessed. We compared the HGS with ERCP/stent regarding the kinetics of bilirubin decrease, the procedure-related morbidity, and the postoperative surgical outcomes.
Results: During the study period, 102 patients underwent pancreaticoduodenectomy or total pancreatectomy for pancreatic malignancy. Preoperative bile drainage was performed in 65 patients (20 HGS, 45 ERCP). HGS was associated with a faster (6 vs. 10 days, $P = 0.042$) and more effective (133 μmol/L vs. 101 μmol/L, $P = 0.037$) reduction of the serum bilirubin levels. HGS was safe and did not differ from ERCP with stent placement concerning post-interventional complications ($P = 0.565$), postoperative mortality ($P = 0.996$) and postoperative morbidity ($P = 0.896$), including infectious complications (wound infection, $P = 0.662$/ intra-abdominal abscess, $P = 0.587$), severe pancreatic fistula ($P = 0.587$), bile leak ($P = 0.131$), and postoperative hemorrhage ($P = 0.886$).
Conclusion: HGS performed in a specialized multidisciplinary hepatopancreatobiliary center is feasible and safe and may result in more accelerated and effective bile drainage compared to the established ERCP. In patients with obstructive jaundice related to pancreatic malignancy unable to undergo adequate bile drainage by ERCP, HGS may be an effective alternative method enabling surgery in a timely manner.

Comparison of long-term survivals following hepatectomy for hepatocellular carcinoma according to the time-point of recurrence and treatment modalities for recurrent disease

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Objective: Disease recurrence following curatively intended hepatectomy for hepatocellular carcinoma (HCC) limits oncologic outcome. Based on the extent, location and time-point of tumor recurrence, different therapeutic modalities are available to treat recurrent HCC. Therefore, our aim was to investigate the role of these treatments and the time-point of recurrence on long-term survival.
Methods: Clinicopathological data of patients, who underwent hepatectomy for HCC at a major hepatobiliary center in Switzerland between 2012 and 2019, were assessed. Patients suffering tumor recurrence were stratified according to the treatment modalities for recurrent HCC including surgical treatment (repeat hepatectomy or liver transplantation), interventional treatment, and conservative treatment (chemotherapy or best supportive care). Groups were compared regarding to overall survival (OS). Additionally, long-term outcomes were compared between patients with early ($\leq$ 12 months) and late ($>$ 12 months) tumor recurrence.
Results: During the study period, 159 patients underwent hepatectomy for HCC. Median follow-up time was 53 months. After a median time of seven (1-64) months, 74 patients were diagnosed with tumor recurrence (47 %). The majority of patients developed early recurrence ($n = 49$) and 58 patients had intrahepatic recurrence only. Treatment options were re-resection, liver transplantation, interventional methods, and palliative therapy in 5, 15, 23, and 31 patients, respectively. Surgical treatment was significantly associated with improved OS compared to interventional and conservative treatment (5-year OS: 84% vs. 39% vs. 30%, $p < 0.0001$). OS was significantly better among patients with late recurrence compared to patients with early recurrence, irrespective of the treatment modality used for the recurrent disease (5-year OS: 70% vs. 38%, $p = 0.008$).
Conclusion: Repeat hepatectomy or liver transplantation for recurrent HCC following hepatectomy is associated with better long-term survival compared to interventional or conservative therapies, especially for patients with late tumor recurrence. Patients with intrahepatic HCC recurrence should be evaluated according to the extent of tumor burden, liver function, and functional status to identify the best candidates for a surgical treatment.

Inhibition of SUMOylation enhances responses to irreversible electroporation in pancreatic cancer

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Objective: The revolutionary results of immunotherapy have not yet translated to pancreatic cancer (PC).
Irreversible electroporation (IRE) is a non-thermal ablative therapy that can generate tumor-specific immune responses, yet not sufficient to eradicate distant metastatic disease. Post-translational protein modification (PTM) by small ubiquitin-like modifier (SUMO) is involved in carcinogenesis and PD-L1 mediated immunosuppression. TAK-981 is a novel inhibitor of SUMOylation that has demonstrated induction antitumor immune responses in preclinical models. Our hypothesis is that TAK-981 will augment the effects of IRE in an immunocompetent orthotopic mouse model of PC.
Methods: The PC cell line (KPC4580P) was derived from an autochthonous tumor arising in a genetically engineered mouse model (KPC). The tumors were implanted orthotopically into the pancreas via laparotomy. Once tumors reached 5-7 mm in diameter, mice were randomized to one of four treatment groups: IRE alone, TAK-981 alone, IRE + TAK-981, or no treatment. IRE versus sham laparotomy (150 x 90 microsec pulses at 1500 V/cm) was performed once through second laparotomy. TAK-981 (7.5mg/kg) versus vehicle was delivered via subcutaneous injection twice weekly x four doses, starting on the day of IRE. Tumors were harvested on day 14 for flow cytometric analysis.
Results: Ultrasound was performed on days 8, 14 and 20 after initiation of treatment. Tumor growth in the IRE + TAK-981 group was significantly inhibited compared to sham-treated tumors (Fig. 1, $^*p=0.0002$), and this effect persisted to day 20, even after treatment with TAK-981 was stopped on day 11 ($p < 0.01$). Flow cytometry revealed a greater than 2-fold increase in CD8+ T-cells (Fig. 2a, $^*p < 0.05$) and 4-fold increase in IFN-gamma+ CD8+ T-cells (Fig. 2b, $^*p=0.01$) in tumors treated with the combination relative to sham-treated tumors.
Conclusion: Our results suggest that the combination of IRE with TAK-981 is associated with better local tumor control and a significant increase of CD8+ T-cells and IFN-gamma+ CD8+ T-cells. We expect that this combination might contribute systemic immune responses that would prevent or even eradicate distant metastasis. Given that immunosuppression mediated by PD-L1 is regulated by ubiquitination and is seen in 50% of PC tumors, targeting PTM with TAK-981 might also render PC responsive to immunotherapy with checkpoint inhibitors.

Major postoperative complications increase tumor recurrence rate and diminish long-term survival following resection for pancreatic ductal adenocarcinoma

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Objective: Major complications have been associated with worse oncologic outcomes following resection for several gastrointestinal malignancies. However, the impact of major postoperative morbidity on the

survival of patients undergoing resection for pancreatic ductal adenocarcinoma (PDAC) remains unclear.
Methods: Clinicopathological data of patients who underwent resection for PDAC between 2014 and 2019 in a major swiss hepatopancreatobiliary center were assessed. We evaluated the disease-free (DFS) and overall survival (OS) of patients suffering a major postoperative complication (grade-3 or higher within 90 days according to Clavien-Dindo classification) in comparison to those of patients without any major postoperative adverse events.
Results: During the study period, 186 patients underwent resection for PDAC with curative intent. Pancreatoduodenectomy, distal pancreatectomy, and total pancreatectomy were performed in 66%, 12%, and 22% of patients, respectively. Major 90-day postoperative morbidity and mortality rate were 21.5% and 4.3%, respectively. After excluding patients who died within 90 days, major postoperative morbidity significantly increased the length of hospital stay [median 22 (8-66) days vs. 13 (5-26) days, $p < 0.0001$] resulting in a delay of returning to intended oncologic treatment and reducing the likelihood of receiving adjuvant chemotherapy (56% vs. 83%, $p = 0.001$). Postoperative major complications were associated with significantly worse DFS (median DFS 10 vs. 16 months, hazard ratio 1.9, 95% confidence interval 1.91-2.96, $p = 0.004$) and worse OS (median OS 14 vs. 37 months, hazard ratio 1.7, 95% confidence interval 1.02-2.75, $p = 0.04$) in multivariate analysis.
Conclusion: Major postoperative complications promote tumor recurrence following resection for PDAC, thus limiting long-term survival. Careful patient selection and optimized complication management may reduce postoperative morbidity, thereby lowering its negative impact on oncologic prognosis.

Prospective trial to evaluate the prognostic value of different nutritional assessment scores for survival in pancreatic cancer surgery

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Objective: Malnutrition is associated with poor survival in pancreatic cancer patients. Nutritional scores show great heterogeneity diagnosing malnutrition. The aim of this study was to find the score best suitable to identify patients with malnutrition related to worse survival after surgery for PDAC.
Methods: Risk of malnutrition was evaluated preoperatively using twelve nutritional assessment scores. Patients were followed-up prospectively for at least 3 years. Patients at risk for malnutrition were compared to those not at risk according to each score using Kaplan Meier survival statistics.
Results: A total of 116 Patients receiving a PDAC resection in curative intent were included. Malnutrition according to the Subjective Global Assessment score (SGA), the Short Nutritional Assessment Questionnaire (SNAQ) and the INSYST2 score was associated with worse overall survival (SGA: at-risk: 392 days; not at-risk: 942 days; $p = 0.001$; SNAQ: at-risk: 508 days; not at-risk: 971 days; $p = 0.027$; INSYST2: at-risk: 538 days; not at risk: 1068; $p = 0.049$). In the multivariate analysis SGA (HR of death 2.22, 95% CI 1.37-3.6, $p = 0.002$) was associated with worse overall survival.
Conclusion: Malnutrition as defined by the Subjective Global Assessment is independently associated with worse survival in resected PDAC patients. The SGA should be used to stratify PDAC patients in clinical studies. If severely malnourished patients according to the SGA profit from intensified nutritional therapy should be evaluated in a randomized controlled trial.

Individual patient data meta-analysis of delayed gastric emptying after pylorus-preserving versus pylorus-resecting pancreatoduodenectomy

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Objective: Some studies have indicated that resecting the pylorus during partial pancreatoduodenectomy (PD) may lead to reduced delayed gastric emptying (DGE). Randomized controlled trials (RCTs) showed conflicting results regarding superiority of pylorus-resecting PD (prPD) compared to the pylorus-preserving procedure (ppPD). The aim of this individual patient data meta-analysis was to investigate risk factors on an individual patient level which may explain the observed differences between the existing RCTs.
Methods: RCTs comparing ppPD and prPD were searched systematically in MEDLINE, Web of Science and CENTRAL. Individual patient data (IPD) from existing RCTs were included. The primary endpoint was DGE according to the International Study Group of Pancreatic Surgery (ISGPS) adjusted for age, sex and body-mass-index (BMI). The meta-regression model was applied to the IPD of the RCTs. Mixed effects models were applied to perform meta-analyses.
Results: IPD from 418 patients (three RCTs) were used for quantitative synthesis. There was no significant statistical difference between ppPD and prPD regarding DGE adjusted for age, sex and BMI (OR 0.72; 95%-CI: 0.41 to 1.22) and DGE grade (RR 1.01; 95%-CI: 0.64 to 1.57). Regarding other relevant perioperative and postoperative outcome parameters, there were also no significant differences among the two techniques.
Conclusion: This IPD meta-analysis comparing preservation and resection of the pylorus during PD confirmed that the resection of the pylorus is not superior to the pylorus-preserving procedure regarding DGE. The pylorus should therefore be preserved whenever possible. Further RCT are futile, because their results are unlikely to change the pooled estimate for DGE.

Extended lymph node resection versus standard resection for pancreatic head and peri-ampullary adenocarcinoma: A systemic review

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Objective: For patients with pancreatic and peri-ampullary adenocarcinoma, it has been hypothesized that extended lymphadenectomy may result in higher R0 resection rates and improved survival. As such, the objective of this systematic review was to compare the oncologic outcomes after pancreaticoduodenectomy (PD) with standard lymphadenectomy (SLA) versus PD with extended lymphadenectomy (ELA).
Methods: A Cochrane systematic review was conducted to identify all randomized controlled trials comparing PD with SLA versus PD with ELA for participants with periampullary or pancreatic cancer. The following electronic databases were reviewed: the Cochrane Central Register of Controlled Trials; MEDLINE; PubMed and EMBASE. The methodological quality of the included studies was assessed using the Cochrane risk of bias criteria and the quality of evidence for important outcomes using GRADE. Extended lymphadenectomy included the interaortocaval space, left side of the celiac trunk, and superior mesenteric artery.
Results: Seven randomized controlled trials were included with 843 patients (421 ELA and 422 SLA). No difference in overall survival (1- and 3-years after surgery) was seen between groups. Mortality and

morbidity rates (including pancreatic fistula, delayed gastric emptying, and postoperative bleeding) were similar between the two groups. Operative time was significantly longer following extended resection (Mean Difference 50.1 min; 95% CI 19.2 to 81.1 min; P = 0.001). Total amount of blood loss during surgery was significantly increased following extended resection (Mean Difference 137 ml; 95% CI 12 to 263 ml; P = 0.03), as well as transfusion requirements (Mean Difference 0.15 units; 95% CI 0.13 to 0.17 units; P < 0.00001).
More lymph nodes were retrieved during ELA (Mean Difference 11 nodes; 95% CI 7 to 15 nodes; P < 0.00001). Incidence of positive resection margins was not different between groups.
Conclusion: There is no indication for extended lymphadenectomy in pancreatic head resection as a routine procedure.

External validation of three nomograms predicting survival using an international cohort of patients with resected pancreatic head ductal adenocarcinoma

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Objective: Lymph node ratio (LNR, positive lymph nodes/collected lymph nodes during surgery) was identified as an important prognostic factor of survival in resected pancreatic cancer. Several nomograms based on LNR were recently proposed to predict survival after pancreatoduodenectomy (PD). The present study aimed to externally validate 3 published nomograms using an international cohort.
Methods: Consecutive patients with ductal adenocarcinoma of the pancreatic head who underwent PD without neoadjuvant treatment from 6 tertiary centers in Europe and the USA were retrospectively collected from 2000 to 2017. Patients with metastases at diagnosis, R2 resection, missing data regarding LNR, and who died within 90 postoperative days were excluded. The 3 selected nomograms were the updated Amsterdam nomogram (including LNR, adjuvant therapy, margin status, and tumor grade), the nomogram by Pu et al. (including LNR, age, tumor grade, and T stage) and the nomogram by Li et al. (including LNR, age, tumor location, grade, size, and TNM stage). Overall survivals (OS) were calculated using Kaplan-Meier method. For the validation, calibration (Hosmer-Lemeshow test), discrimination capacity (ROC curves for 3-year OS), and clinical utility (sensitivity and specificity at the value of Youden index) were assessed.
Results: After exclusion of 95 patients with metastases, R2 resection, and who died within 90 postoperative days, 1167 patients were included. Median OS of the entire cohort was 23 months (95% confidence interval: 21-24).
For the 3 nomograms, Kaplan-Meier curves showed significant diminution of OS with increasing scores ($p < 0.01$ for the 3 nomograms). All nomograms showed good calibration (non significant Hosmer-Lemeshow goodness-of-fit tests). For the updated Amsterdam nomogram, the area under the ROC curve (AUROC) for 3-year OS was 0.66. Sensitivity and specificity were 73% and 50%. Regarding the nomogram by Pu et al., the AUROC was 0.67. Sensitivity and specificity were 65% and 60%. For the nomogram by Li et al., the AUROC was 0.67, while sensitivity and specificity were 56% and 71%.
Conclusion: The 3 selected nomograms were validated using an external international cohort and displayed interesting and comparable predictive values. Those nomograms may be used in clinical practice to estimate survival after PD for ductal adenocarcinoma.

Endocrine

Measurement of serum intact parathyroid hormone (iPTH) at the end of total thyroidectomy: A reliable parameter for hypocalcemia?

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Objective: Total thyroidectomy represents the gold standard surgical procedure for patients with malignant thyroid disease. Over the past decades, the total thyroidectomy gradually replaced the subtotal thyroidectomy for benign thyroid disorders as well. Postoperative hypocalcemia remains the most frequent complication. The close proximity of parathyroid glands to the thyroid capsule leads often to devascularization or adventitious removal of parathyroid tissue. Clinical symptoms like paresthesia, tingling, muscle cramps or seizures often occur. Combined measurement of intact parathyroid hormone (iPTH) and calcium after the operation are used worldwide to predict postoperative hypoparathyroidism. The purpose of this study was to find out the incidence of decreased iPTH at the end of surgery and its reliability in predicting hypocalcemia.
Methods: We performed a retrospective analysis of 534 patients who underwent total thyroidectomy at our institution between 2000 and 2019. Medical records were reviewed to analyze the patient characteristics, indication of the procedure, laboratory and histological results, postoperative management and complications. The iPTH was measured before and at the end of the surgery, while the calcium was measured at the first postoperative day. The iPTH assay at our hospital has a normal range between 15.0 and 80.0 pg/ml. Meanwhile hypocalcemia was defined as a calcium measurement < 2.2 mmol/l.
Results: The mean age of the patients was 55.34 years. The female to male ratio was 4.6:1. The mean preoperative iPTH of our cohort was 48.35 pg/ml, while the postoperative iPTH was 31.74 pg/ml, indicating a mean reduction of 35.75%. A total of 174 patients (32.6%) had a iPTH < 15.0 pg/ml at the end of the surgery, indicating a reduction of 75.6%. 22 of these 174 patients (12.6%) developed clinical symptoms of hypocalcemia. In contrast only 3 patients (0.08%) with normal iPTH developed symptoms. Whole parathyroid glands were identified in 95/534 (17.8%), whereas from the 174 patients with iPTH < 15.0 pg/ml, 56 (32.2%) had at least one parathyroid gland in the operative specimens.
Conclusion: Measurement of iPTH at the end of total thyroidectomy is a good predictor to detect patient who are at risk for developing symptomatic hypocalcemia and calcium substitution can be started at the same day. A normal iPTH almost excludes symptomatic hypocalcemia.

18F-Fluorcholine-PET/CT for localizing hyperfunctioning parathyroid glands and optimizing surgical treatment in patients with hyperparathyroidism

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Objective: Hyperparathyroidism (HPT) is a common endocrine disorder. Definitive cure can only be reached by surgical removal of all diseased glands. The surgical strategy and management continue to evolve. Exact preoperative localization of hyperfunctioning glands is of paramount importance to prevent unnecessary surgical exploration. Unfortunately, the number of false negative or inconclusive results in standard imaging techniques is rather high. The aim of this study is to evaluate the diagnostic accuracy of 18F-Fluorcholine-PET/CT (FCH-PET/CT) and its sensitivity in a large cohort of patients with primary as well as secondary/tertiary and familial HPT with negative and/or discordant findings in ultrasound and/or 99mTc-sestamibi scintigraphy/SPECT/CT.

Methods: Between 2015 and 2020 96 patients with HPT and negative/equivocal conventional imaging were referred for FCH-PET/CT. 69 patients who have undergone surgery and histopathologic workup were analyzed in this retrospective single institution study. 60 patients suffered from primary HPT, 4 from secondary or tertiary HPT and 5 from familial HPT. Sensitivities, positive predictive values, and accuracies were calculated.

Results: All patients showed normalized serum calcium levels in the direct postoperative period.

50 of 60 patients (8 results are awaited) with primary HPT and 4 of 4 patients with secondary/tertiary HPT showed normal calcium levels after 6 months and were cured. 4 of 5 patients with familial HPT were cured as well while 1 patient deceased before 6 month follow up. Sensitivity per lesion for primary HPT was 88%, for secondary/tertiary HPT 75% and for familial HPT 75%, respectively. Sensitivity per patient was 92% for primary HPT, 100% for secondary/tertiary HPT and 50% for familial HPT, respectively. Positive predictive value was 98% in primary HPT and 100% in secondary/tertiary HPT and 100% in familial HPT as well.

Conclusion: Diagnostic accuracy of 18F-Fluorcholine-PET/CT for patients with primary as well as secondary/tertiary and familial hyperparathyreoidism ist excellent . 18F-Fluorcholine-PET/CT is a valuable tool for endocrine surgeons to optimize the surgical treatment of patients with hyperparathyroidism.

Bariatric Surgery and Hernias

Trocar site closure with a novel anchor-based (neoClose®) system versus standard suture closure: A prospective randomized controlled trial

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Objective: Patients with obesity have a higher risk of trocar site hernia. The objective of the present study was to compare a standard suture passer versus the neoClose® device for port site fascial closure in patients with obesity undergoing laparoscopic bariatric surgery.

Methods: This is a randomized, controlled trial with two parallel arms. Thirty five patients with BMI $\geq$ 35 kg/m2 and undergoing laparoscopic sleeve gastrectomy or Roux-en-Y gastric bypass were randomized to each group. Port site fascial closure for trocars $\geq$ 10 mm was performed with the neoClose® device in the study group and the standard suture passer in the control group. Primary outcomes were time required to complete closure and intensity of postoperative pain at the fascial closure sites. Secondary outcomes were intraabdominal needle depth and incidence of trocar site hernia.

Results: The use of the neoClose® device resulted in shorter closure times (20.2 vs 30.0 s, $p = 0.0002$), less pain (0.3 vs 0.9, $p = 0.002$) at port closure sites, and decreased needle depth (3.3 cm vs 5.2 cm, $p < 0.0001$) compared to the standard suture passer. There was no trocar site hernia at the one-year follow-up in either group.

Conclusion: Use of the neoClose® device resulted in faster fascial closure times, decreased intraoperative needle depth, and decreased postoperative abdominal pain at 1 week as compared to the standard suture passer. These data need to be confirmed on larger cohorts of patients with longer follow-up, especially in terms of long-term hernia recurrence rates.

Robotic inguinal hernia repair (rTAPP) – A series of 300 cases

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Objective: While inguinal hernia repair using mesh is the recommended standard for most patients, minimal invasive techniques experienced a prolonged process until broad acceptance and sufficient expertise. Lately, a reluctance towards the integration of robotic hernia repair as a standard procedure is observed in Europe compared to the US. Nevertheless, robotic technology is a powerful tool for increasing quality in standardized procedures. We present a large case series of inguinal hernias repaired by robotic surgery.

Methods: All consecutive patients receiving a robotic inguinal hernia repair with a transabdominal approach (rTAPP) in the first 18 months (May 2018 up to October 2019) after introduction of the DaVinci Xi system at our institution were included in this study.

Results: Overall, 302 groin hernias in 225 patients were operated in the defined period. 77 patients presented with bilateral hernias. Mean age of patients was 58.7 years, 87.6% were men. Mean BMI 25.5kg/m2.

Nearly half of all operations were teaching operations making use of the available double consoles. While in the first 6 months only 20.0% of operations were teaching procedures, the rate increased to 60.3% in the last 6 months of the observation period.

While overall 35.6% of procedures were performed as day-surgery, the rate varied over the course of the study with 35.6% in the first 6 months, 46.0% in the second and 33.3% in the last 6 months.

Operation time was 82.6min. (range 40-186) with 72min. (range 40-186) for unilateral repairs and 101.3min. (range 52-169) for bilateral repairs. Further subgroup analysis showed that in bilateral repairs in primary hernias teaching vs. no-teaching operations differed only marginally in time (108.9min., range 66-149 vs. 91.6min., range 52-159).

Follow-up data was available for 93.8% of patients. There were no cases of recurrence; two patients experienced postoperative pain lasting more than 30 days. Seroma was observed in 8.9%, haematoma in 4.4% cases. Urinary retention occurred in 3.6% of patients, PE in 0.4%, DVT in 0.4%, epididymitis in 3.1%.

Conclusion: Robotic inguinal hernia repair is an outstanding and safe procedure. The operative accuracy of the system is impressive. The availability of two consoles makes it an ideal teaching tool, allowing to train residents in inguinal hernia repair, in a high standard of safety and with good outcomes.

Performing total extraperitoneal inguinal hernia repair in patients with previous abdominal surgery is safe: an analysis of 1591 patients

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Objective: The safety of endoscopic total extraperitoneal inguinal hernia repair (TEP) in patients who previously underwent open lower abdominal surgery has been discussed for many years, since operative difficulties can be expected due to adhesions and scarring. Some research has been done in this area, most of which ask for further studies to be conducted. The aim of this study was to assess the safety and feasibility of TEP in patients with previous lower abdominal surgery (PLAS).

Methods: We retrospectively analysed all patients who underwent a TEP inguinal hernia repair at our institution between July 2012 and May 2018. Previous lower abdominal surgery (PLAS) was defined as any previous open surgery with scarring below the umbilicus. In case of scars outside the midline, these were defined as PLAS when on the same side as the operated inguinal hernia. A univariate analysis as well as logistic regression were performed to identify outcomes of surgery between patients with- and without PLAS.

Results: In total 1591 patients were included in the study. 274 patients had PLAS, corresponding to 17.2%. Comparing to patients without PLAS, the group with PLAS had a significant higher risk of increased operation duration (odds ratio 1.07, p-value 0.004), but no increased risk of conversion, or intra- or postoperative complications. The highest significant risk of increasing operation duration was found after aortoiliac surgery (OR 2.08), bladder surgery (OR 1.71) or prostate surgery (odds ratio 1.22).

Conclusion: Performing TEP inguinal hernia repair after lower abdominal surgery slightly increases the operation duration, however there is no negative effect on the length of stay and the complication- or conversion rate. Therefore, we consider TEP to be a feasible and safe operation technique also for patients who previously underwent open lower abdominal surgery.

Does the non-absorbable suture closure of the jejunal mesenteric defect reduce the incidence and severity of internal hernias after laparoscopic Roux-en-Y gastric bypass?

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Objective: Internal hernias (IH) are frequent complications after laparoscopic Roux-en-Y gastric bypass (LRYGB). Closure of the jejunal mesenteric and the Petersen defect reduces IH incidence in prospective and retrospective trials. This study investigates whether closing the jejunal mesenteric space alone by non-absorbable suture and splitting the omentum can be beneficial to prevent IH after LRYGB.
Methods: Observational cohort study of 785 patients undergoing linear LRYGB including omental split at a single institution, 493 without jejunal mesenteric defect closure, 292 with closure by non-absorbable suture with a minimal follow-up of 2 years. Patients were assessed for appearance and severity of IH. Additionally, open mesenteric gaps without herniated bowel, as well as early obstructions due to kinking of the entero-enterostomy (EE) were explored.
Results: By primary mesenteric defect closure, the rate of manifest jejunal mesenteric and Petersen IH could be reduced from 6.5% to 3.8%, but without reaching statistical significance. The most common location for an IH was the jejunal mesenteric space, where defect closure during primary surgery could reduce the rate of IH from 5.3% to 2.4%. Higher weight loss seemed to increase the risk of developing an IH.
Conclusion: The closure of the jejunal mesenteric defect by non-absorbable suture can reduce the rate of IH at the jejunal mesenteric space after LRYGB. However, the beneficial effect in our collective is smaller than expected, especially in patients with excellent weight loss. Petersen IH rate remained low by consequent T-shape split of the omentum without suturing of the defect.

Defining global benchmarks in elective secondary bariatric surgery comprising conversional, revisional and reversal procedures

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Objective: Management of poor response and of long-term complications after bariatric surgery (BS) is complex and under-investigated. Indications and types of reoperations vary widely and postoperative complication rates are higher compared to primary BS. Benchmarking uses best performance in a given field as reference point for improvement. Our aim was to define "best possible" outcomes for elective secondary BS.
Methods: The establishment of benchmarks in secondary BS followed a standardized methodology, based on recommendations of a Delphi consensus panel of experts. This multicenter study analyzed patients undergoing elective secondary BS in 18 high-volume centers on 4 continents from 06/2013 to 05/2019. Twenty-one outcome benchmarks were established in low-risk patients, defined as the 75th percentile of the median outcome values of the centers. Benchmark cases had no: previous laparotomy, diabetes, sleep apnea, cardiopathy, renal insufficiency, inflammatory bowel disease, immunosuppression, history of thromboembolic events, BMI>50kg/m2 or age>65 years. Descriptive statistics, multivariate logistic regression and data visualization were performed using the R software.
Results: Out of 44'884 elective bariatric procedures performed in the participating centers, 5'328 secondary BS cases were identified. The benchmark cohort included 3143 cases, mainly females (85%), aged 43.8±10 years, 8.4±5.3 years after primary BS, with a body mass index 35.2±7kg/m2. Main indications were insufficient weight loss (43%) and gastro-esophageal reflux disease/dysphagia (25%). 90-days postoperatively, 14.57% of benchmark patients presented ≥1 complication, mortality was 0.06% (n = 2). Significantly higher morbidity was observed in non-benchmark cases (OR 1.36) and after conversional or revisional procedures with gastrointestinal suture/stapling (OR 1.7). Benchmark cutoffs at 90-days postoperatively were ≤5.8% re-intervention and ≤8.8% re-operation rate. At 2-years (IQR 1-3) 15.6% of benchmark patients required a reoperation.
Conclusion: Secondary BS is safe, although postoperative morbidity exceeds the established benchmarks for primary BS. The excess morbidity is due to an increased risk of gastrointestinal leakage and higher need for intensive care. The considerable rate of tertiary BS warrants expertise and future research to optimize the management of non-success after BS.

Long-term effects of laparoscopic sleeve gastrectomy and Roux-Y-gastric bypass on body composition and bone mass density

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Objective: Currently, the two most common bariatric procedures are laparoscopic sleeve gastrectomy (LSG) and laparoscopic gastric bypass (LRYGB). Long-term data comparing the two interventions in terms of their effect on body composition and bone mass density (BMD) is scarce. The aim of this study was to assess body composition and BMD at least five years after sleeve gastrectomy (LSG) and gastric bypass (LRYGB).
Methods: Bariatric patients at least five years post-surgery (LSG or LRYGB) were recruited and body composition and BMD was measured

by means of DEXA. Data from body composition before surgery was included in the analysis. Blood samples were taken for determination of plasma calcium, parathyroid hormone (PTH), Vitamin D3, alkaline phosphatase and C-terminal telopeptide (CTX), and individual risk for osteoporotic fracture assessed by The Fracture Risk Assessment Tool (FRAX) score was calculated. After surgery, all patients received multivitamins, vitamin D3, and zinc. In addition, LRYGB-patients were prescribed calcium.

Results: A total of 142 patients were included, 72 LSG and 70 LRYGB, before surgery: median BMI 43.1 kg/m2, median age 45.5 years, 62.7% females. Follow-up after a median of 6.7 years. For LRYGB, percentage total weight loss (%TWL) at follow up was 26.3%, and for LSG 24.1%, ($p = 0.243$). LRYGB lead to a slightly lower fat percentage in body composition. At follow-up, 45% of both groups had a T-score at the femoral neck below -1, indicating osteopenia. No clinically relevant difference between the groups in BMD was found.

Conclusion: At 6.7 years post-surgery, no difference in body composition and BMD between LRYGB and LSG was found. Deficiencies and bone loss remain an issue after both interventions and should be monitored.

Incidence and prognostic factors for the development of symptomatic and asymptomatic marginal ulcers after Roux-en-Y gastric bypass procedures

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Objective: Marginal ulcer (MU) is a serious complication after Roux-en-Y gastric bypass (RYGB) procedures. This study reports the incidence, risk factors and treatment outcomes of symptomatic and incidentally, at routine endoscopy diagnosed, MU.

Methods: All patients undergoing RYGB procedures between 2013 and 2018 at a single center were included. Upper endoscopy was performed in case of symptoms and/or routinely 2 and 5 years postoperatively.

Results: 568 patients (83.3% female) underwent RYGB procedure with a median age of 40 years and median initial body mass index of 41 kg/m2. Median time to follow-up was 2.99 years. Routine 2- and 5-year upper endoscopy was performed in 256 (55.3%) and 65 (38.0%) eligible patients, respectively. In 86 (15.1%) patients, MU was diagnosed at a median time of 14.2 months (4.58 – 26.2) postoperatively and 24.4% of patients with MU were asymptomatic. 76.7% of MUs were located on the side of the Roux-limb. 88.4% of MUs were treated conservatively; re-operation was necessary in 10 (11.6%) patients. Smoking and type 2 diabetes mellitus were the only independent risk factors for MU development in multivariate analysis with a hazard ratio of 2.65 and 1.18 (HbA1c per unit >6.0), respectively.

Conclusion: MU is a common complication after gastric bypass surgery with 25% of patients being asymptomatic. Follow-up routine endoscopy is recommended for early MU detection and subsequent accurate therapy, especially in patients with the independent risk factors smoking and type 2 diabetes mellitus.

Recurrent internal hernias after Roux-en-Y gastric bypass: An observational study in 1219 patients over 20 years

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Objective: Internal hernia (IH) represents a well-known complication and the major cause of bowel obstruction after Roux-en-Y gastric bypass (RYGB) for morbid obesity. With the worldwide rise of performed RYGB, IH will become more frequent in the coming years. Lots of studies already addressed this issue to prevent its occurrence and improve its management. The aim of this study is to assess incidence and patterns of recurrence of IH.

Methods: A retrospective single-centre analysis was performed of prospectively collected follow-up data from patients who underwent a RYGB between January 2000 and December 2017 and who developed IH thereafter. Follow-up data were reviewed until December 2020. Both open (51) and laparoscopic procedures (1168) were included. All RYGB were performed using the antecolic technique with routine closure of the Petersen's space (PS) and the mesenteric defect beneath the jejunojejunostomy (JJ). Only open mesenteric defects with incarcerated small bowel at the time of operation were considered as IH.

Results: One hundred thirty four patients presented with IH and all events occurred in the laparoscopic group (11.5%). Among the 134 patients with IH, a recurrence was observed in 35 patients (26.1%) after a median time of 13 months (range, 0-124) since the first IH. Seven patients presented more than 2 episodes of IH, among them one patient with 7 episodes. The median weight loss between the first and the second episode of IH was 0.0kg (range, -11.5-19.0) and the median percentage of excess weight loss achieved since the RYGB at the occurrence of the second IH was 97.2% (range, 55.3-111.2). Location of IH was PS in 70 patients (52.2%) at the time of the first IH and in 23 patients (65.7%) at the time of the second IH. Recurrence of IH at the same location was more frequent at the PS (22.9%) than at the JJ (10.9%). Overall, 185 operations for IH were performed, among them 132 (71.4%) laparoscopically. Only once, a small bowel resection was mandatory (0.5%).

Conclusion: For patients with laparoscopic RYGB, internal hernias represent a potential complication over a lifetime and have to be suspected even years after the index operation. One quarter of patients will develop a recurrence of IH and Petersen's space is mostly involved.

Roux-en-Y gastric bypass with a long compared to a short biliopancreatic limb leads to better weight loss and glycemic control in obese mice

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Objective: Roux-en-Y gastric bypass (RYGB) shows durable long-term weight loss and control of comorbidities in randomized controlled trials. However, the impact of the proportions of the biliopancreatic limb (BPL) and the total alimentary limb (TALL) on weight loss or glucose metabolism is still unclear.

Methods: Six weeks old C57BL/6J mice were fed high fat diet (HFD) to induce obesity and glucose intolerance. Mice underwent RYGB surgery with a very-long BPL (35% of total bowel length [TBL]), long BPL (25% of TBL), short BPL (15 % of TBL), or sham surgery. The alimentary limb (AL) was adjusted in dependency on the BPL to achieve a fixed CC length. Glycemia was assessment by intraperitoneal glucose tolerance tests.

Results: Mice undergoing RYGB with a very-long BPL showed excessive weight loss and mortality and were therefore excluded for further analyses. Total weight loss (TWL%) was significantly higher in the long BPL-compared to short BPL-group. Mice with a long BPL showed significantly improved glucose tolerance 14 days postoperatively, while 35 days postoperatively, the improvement in glucose tolerance with a long BPL was much less distinctive.

Conclusion: RYGB with a longer BPL leads to improved results including weight loss and glucose tolerance. However, the metabolic improvements seem to decrease over time. These findings could potentially be translated to humans by adjusting the BPL according to body weight and comorbidities. To avoid possible negative effects of a longer BPL total bowel length measurement is mandatory.

Long-term effects of laparoscopic sleeve gastrectomy: What are the results beyond 10 years?

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Objective: Sleeve gastrectomy (SG) has become the most commonly performed bariatric procedure worldwide. Newer studies providing

long-term follow-up are showing high incidence of weight regain and high incidence of de novo reflux or worsening of preexisting GERD leading to conversion to different bariatric procedure. The objective of our study was to present 5 to 15-year follow-up results in terms of weight loss, remission of comorbidities and reoperation rate.
Methods: This is a retrospective analysis of prospectively collected data. The minimal follow-up time was 5 years. Patients who underwent SG between August 2004 and December 2014 were included. In case of reoperation patients were converted to Roux-en-Y gastric bypass or biliopancreatic diversion type duodenal-switch with or without hiatal hernia repair.
Results: A total of 307 patients underwent SG either as primary bariatric procedure (n = 262) or as redo operation after failed laparoscopic gastric banding (n = 45). Mean body mass index at time of primary SG was 46.4 ± 8.0 kg/m2. Mean age at operation was 43.7 ± 12.4 years with 68% females. Follow-up was 84% and 70% at 5 and 10 years respectively. The mean EBMIL for primary SG was 62.8 ± 23.1% after 5 years, 53.6 ± 24.6% after 10 years and 51.2 ± 20.3% after 13 years. Reoperation after SG was necessary in almost every fifth SG patient: 24 patients (7.8%) were reoperated due to insufficient weight loss, 12 patients (3.9 %) due to reflux, while 23 patients (7.5%) needed conversion due to both, insufficient weight loss and reflux. Comorbidities improved considerably while the incidence of new onset reflux was 29.7%.
Conclusion: SG provides a long-term EBMIL from 51 to 54% beyond 10 years and a significant improvement of comorbidities. On the other hand, a high incidence of both weight loss failure and de novo reflux was observed leading to conversion.

Acute Care Surgery

Comparison of injury patterns between electric bicycle, bicycle and motorcycle accidents

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Objective: Electric bicycles (E-bikes) are an increasingly popular means of transport, especially in the current Covid-19 pandemic situation. Accident statistics show that E-bikes are growingly involved in traffic accidents. This study evaluates the injury pattern and severity of E-bike injuries in direct comparison to injuries in motorcycle and bicycle accidents.
Methods: In a retrospective cohort study, the data of 1796 patients who were treated at a Level I Trauma Center between 2009 and 2018 due to traffic accident, involving bicycles, E-bikes or motorcycles, were evaluated and compared with regard to injury patterns and injury severity. Accident victims treated as inpatients with at least 16 years of age were included in this study. Pillion passengers and outpatients were excluded.
Results: The following distribution was found in the individual groups: 67 E-bike, 1141 bicycle and 588 motorcycle accidents. The injury pattern of E-bikers resembled that of bicyclists much more than that of motorcyclists. The patients with E-bike accidents were almost 14 years older and had a higher incidence of moderate traumatic brain injuries than patients with bicycle accidents. Considering the E-bike riders wore nearly twice as often a helmet as bicycle riders. In comparison, the motorcyclists involved in an accident had fewer facial injuries, but more frequent and more serious injuries to the spine, abdomen and lower extremities.
Conclusion: The overall E-bike injury pattern is similar to that of cyclists. The differences in the injury pattern to motorcycle accidents could be due to the higher speeds at the time of the accident, the different protection and vehicle architecture. What is striking, however, is the higher age and the increased craniocerebral trauma of the E-bikers involved in accidents compared to the cyclists. Older and untrained people who have a slower reaction time and less control over the E-bike could benefit from head protection or practical courses similar to motorcyclists.

Increased incidence of complicated acute appendicitis after the first COVID-19 pandemic peak: Have patients a different attitude towards COVID-hospitals?

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Objective: The 11 March 2020 the World Health Organisation considered the COVID-19 Infection a pandemic disease. Between March and May 2020, the region of southern Switzerland was affected by the first pandemic peak, which was managed by dividing hospitals in Covid and non Covid facilities and by reducing elective surgery. At the end of the pandemic peak hospitals returned to their original structure but there was concern as to possible avoidance of former COVID facilities by patients because of fear of contracting of COVID-19 infection. For acute situations such as acute appendicitis, this could imply a delay of treatment. The aim of this retrospective study is to analyse the increment in incidence of complicated appendicitis in the post-pandemic period at our institution.
Methods: Clinical data of patients who underwent appendectomies in the period before and after the COVID-19 pandemic were analysed and compared. Diagnosis was based histopathological examination and/or on intra-operative or CT findings. Complicated appendicitis was defined as the presence of perforated or gangrenous appendicitis on histopathology or the presence of an abscess on CT scan. The incidence of complicated appendicitis, the time between onset of symptoms and patient admission (TOSA), the initial inflammatory blood tests and the complication rate was compared between the two periods.
Results: 79 patients were included in the study, 31 in the post-COVID-19 peak group (A), April - October 2020, and 48 in the pre-pandemic group (B), April - October 2019. Incidence of complicated appendicitis was significantly higher in group A (55% vs 14% p = 0.02). These findings correlate with a greater TOSA (mean time 35 hours vs 17 hours, p = 0.01) and higher inflammatory values in the initial blood test, (mean WBC count 14.8 G/l vs 12.9 G/l, p = 0.08 and mean CRP value 73 mg/l vs 43 mg/l, p = 0.01) in group A.
Conclusion: Our data show a clear increase of incidence of complicated acute appendicitis after the pandemic peak in our hospital. Indeed patients tended to wait longer to visit our emergency department after the pandemic peak. One explanation is a possible fear by the patients of contracting COVID-19 infection in a former COVID hospital. Management of surgical emergencies during and after a pandemic peak phase should take into account the fact that patients may wait longer to visit a doctor thus aggravating the degree of their disease.

Damage-control surgery in patients with non-traumatic abdominal emergencies: A meta-analysis

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Objective: After the successful implementation in trauma patients, damage control surgery (DCS) is being increasingly used in non-traumatic abdominal emergencies, too. However, non-trauma DCS (NT-DCS) is currently a matter of debate and has not yet been comprehensively assessed. The aim of this meta-analysis was to investigate the effect of NT-DCS on mortality in patients with abdominal emergencies.
Methods: Systematic literature search using PubMed. Original articles addressing mortality in patients undergoing NT-DCS or non-trauma conventional surgery (NT-CS) for abdominal emergencies were included. Descriptive statistics and two meta-analyses were performed. Meta-analysis 1 compared mortality in patients undergoing NT-DCS vs. NT-CS. Meta-analysis 2 assessed the observed vs. expected mortality rate, based on APACHE, POSSUM and SAPS scores, in the NT-DCS group. Continuous and categorical variables were reported as weighted means and proportions. Effect sizes were described as risk differences (RD) with 95% confidence intervals (CI).
Results: Literature search revealed 1314 articles. Of these, 21 studies published 2004-2019 were included. NT-DCS was performed in 1238 and NT-CS in 936 patients. In the NT-DCS vs. NT-CS group mean age was 61.0 vs. 64.9 years and the proportion of male patients 58.6% vs. 52.9%, respectively. Most frequent indications for NT-DCS were hollow

viscus perforation (28.4%), mesenteric ischemia (26.5%), anastomotic leak (19.6%), haemorrhage (18.4%), abdominal compartment syndrome (17.4%), bowel obstruction (15.5%), and pancreatitis (13.1%). In meta-analysis 1, mortality was not significantly different in the NT-DCS vs. NT-CS group (RD 0.09, 95% CI -0.06/0.24). Meta-analysis 2 revealed a significantly lower observed than the expected mortality rate in patients undergoing NT-DCS (RD -0.18, 95 % CI -0.29/-0.06). Heterogeneity of included studies was high in both meta-analyses (I2=89.0% and 79.9%, respectively).

Conclusion: This meta-analysis revealed no significantly different mortality in patients with abdominal emergencies undergoing NT-DCS vs. NT-CS. However, observed mortality was significantly lower than the expected mortality rate in the NT-DCS group, suggesting a benefit of the DCS approach. Based on these results, the effect of DCS in patients with non-traumatic abdominal emergencies remains unclear. Further prospective investigation into this topic is warranted.

Polytrauma and Pelvis

Distinct fracture characteristics influence decision making and patient management in fragility fractures of the pelvis – an alternative approach for fracture evaluation

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Objective: Pelvic ring fractures in the elderly with osteoporotic bone are often caused by a minor trauma. A separate classification for these fragility fractures of the pelvis (FFP) has been proposed by Rommens. However, at our institution the management algorithm is rather based on patient profile, clinical course and the ability to mobilize than on the fracture category. We aimed to identify fracture characteristics that might better reflect clinical decision making and show an association with outcome.

Methods: Four fracture characteristics were investigated as potential variables: 1. Extent of the dorsal pelvic ring fracture (absent, unilateral, bilateral); 2. Extent of the ventral pelvic ring fracture (absent, unilateral, bilateral); 3. Ventral comminution/dislocation; 4. Presence of a horizontal sacral fracture.

These four characteristics were assessed retrospectively in a series of 548 patients with a CT scan proven FFP. The association of the fracture morphology with the decision to perform surgery, failure of conservative treatment and the length of hospital stay (LOS) was determined.

Results: Three of the four evaluated characteristics showed an independent and significant association with clinical decision making and patient management. In particular the extent of the dorsal fractures was identified as an independent risk factor for the decision to perform surgery with a 7.3-fold increase per category ($p < 0.001$). The same was observed for the presence of ventral comminution/dislocation ($OR = 2.4$; $p = 0.002$). The extent of ventral fractures ($OR = 1.5$; $p = 0.047$) was an independent risk factor for a longer LOS in conservatively treated patients.

Conclusion: Three evaluated morphologic aspects of FFPs showed a clear and independent relation to current clinical decision making and patient management at our institution. Importantly, the ventral fracture component has been shown to have major impact on treatment decision and outcome, which has been underestimated in the current FFP classification system.

These four easily distinguishable fracture characteristics have the potential to form the basis of an alternative classification system that matches clinical reality and captures prognostic aspects.

Comparison of two whole-body computer tomography protocols for polytrauma patients

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Objective: The use of whole-body computed tomography (CT) is an established standard primary diagnostic method in the work up of polytrauma patients. The protocols used for such CTs however vary between trauma centers. In our Level 1 trauma Centre the protocol was changed from a three phase to a two phase protocol with different positioning of the patient. The primary aim of this study was to compare the estimated radiation dose and scan duration of the two protocols. The secondary aim was to evaluate whether the revision of the CT protocol led to a reduction of required additional imaging of the upper extremities.

Methods: For this retrospective, cross-sectional study two groups of consecutive trauma patients, which were treated in a level 1 trauma center in Switzerland and received a whole-body CT were analyzed. Group A consisted of patients, who presented between January and August 2016. These patients received a three-phased CT in which a repositioning of the arms from the side of the torso to above the head between phases two and three was needed. Group B consisted of those, who presented between January and July 2017. These patients received a CT according to a revised protocol, which was performed in two phases with the arms positioned ventral on a pillow to the torso throughout the entire CT. Scan duration, estimated radiation dose, number of upper extremity injuries, number of addition imaging (xray and CT) of the upper extremities within 24 hours of initial CT.

Results: A total of 182 patients were included in group A and 218 in group B. Baseline characteristics didn't differ, except for there being more males in group B (p 0.006). The estimated radiation dose was lower (15.0 mSv vs 22.9 mSv, $p < 0.001$) and the scan duration shorter (4 vs 7 minutes, $p < 0.001$) in group B. No difference could be shown in the number of upper extremity injuries detected. Further, the number of additional images of the upper extremities needed within 24 hours of the initial CT did not differ between the groups.

Conclusion: Both the estimated radiation dose and the scan duration of a whole-body CT scan in trauma patients can be reduced when a two phase protocol in which the arms are positioned on a pillow ventral to the torso is used instead of a three phase protocol with repositioning of the arms. The amount of additional imaging of the upper limb could not be reduced by having the arms visible on the scan.

Development of a visual analytics tool for polytrauma patients: Proof of concept for a new assessment tool using a multiple layer sankey diagram in a single-center database

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Objective: Early physiological assessment of multiply injured patients is crucial for decision-making and has relied on personal experience of trauma experts. We have developed a new visual analytics tool (Sankey diagram, Watson Trauma Health care tool) that includes known prognostic parameters for polytrauma patients to help guide assessment and treatment decisions for physicians involved in trauma care.

Methods: A prospectively collected trauma database of a single level I trauma center (3655 patients) was used. Inclusion criteria: age > 16 years, an Injury Severity Score (ISS) > 16, and presence of a complete data set in the database. Data collected included admission values of patient age, injury scoring, shock classification, temperature, acid-base and hemostasis parameters. All of these parameters were collected daily as longitudinal parameters. Endpoints of the clinical course we considered were sepsis, SIRS and early in-hospital mortality (<72 hours). A proof of concept of the visualization was developed over a 2-year period in a cooperation between physicians and engineers. Statistically, the most predictive parameters were selected by binary logistic regression and ROC analysis.

Results: A dynamic interactive multi-layer Sankey diagram, based on cohort similarities, was developed in a collaboration between a level I

trauma center and IBM, from August 2017 until January 2018. It is a modular tool and allows any user to add a new patient, or work with an existing case. The visualisation used the Data-Driven Documents (D3) interactive visualisation library to create a responsive graphic.
Conclusion: This application summarizes the experience of 3655 polytrauma patients and might serve as a guide for clinical decisions and educative purposes, as well as new scientific questions for the polytrauma patient.

Validation of a visual-based analytics tool to predict outcomes of polytrauma patients: The IBM WATSON trauma pathway explorer

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Objective: Big data-based artificial intelligence (AI) is on the way to develop into a part of daily clinical life and its reasonable application could help to improve disease or injury outcomes. A visual polytrauma analytics tool based on IBM WATSON was developed and described in a previous publication. The present article relates to the validation of the IBM WATSON Trauma Pathway Explorer.
Methods: A retrospective prediction model validation in a level I trauma center including 107 patients with an Injury Severity Score (ISS) $\geq$16 and age $\geq$16 was performed. Age, ISS, temperature and the presence of head injury were the predictors used to validate the following three outcomes: SIRS and sepsis within 21 days since admission of the patient, as well as early death within 72 hours since admission. The area under the receiver operating characteristic (ROC) curve was used to determine predictive quality. Calibration plots showed the graphical goodness of fit. The Brier score assessed the overall performance of the two models.
Results: The area under the curve (AUC) is 0.77 (95% CI: 0.679-0.851) for SIRS, 0.71 (95% CI: 0.578-0.831) for sepsis and 0.90 (95% CI: 0.786-987) for early death. The Brier scores are as follows: early death 0.06, sepsis 0.12 and SIRS 0.15.
Conclusion: The validation has shown that the predictive performance of WATSON for SIRS and early death corresponds to the clinical outcome in nearly 80% of cases and 90% of cases, respectively. The concordance for sepsis was modest with over 70% of cases. This visual analytics tool for polytrauma patients can be used to obtain valid predictions for SIRS, sepsis and early death. Here, we can present a possible working variant of AI in trauma surgery.

IBM WATSON Trauma Pathway Explorer outperforms the TRISS score to predict early death after polytrauma

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Objective: In recent years, several big data-based artificial intelligence (AI) systems have found its way in health care, one of which we present here: The IBM WATSON Trauma Pathway Explorer, a visual analytics tool to predict early death in polytrauma patients. The aim of this study was to compare the predictive performance of the Trauma Pathway Explorer for early in-hospital mortality with an established trauma scoring system, the Trauma Revised Injury Severity Score (TRISS).
Methods: A retrospective comparative accuracy study in a level I trauma center including patients with an Injury Severity Score (ISS) $\geq$16 and age $\geq$16 was performed. The compared outcome was early death within 72 hours since admission of the patient. The area under the receiver operating characteristic curve (AUC) was used to measure discrimination. Hosmer-Lemeshow statistics was calculated to analyse calibration of the two predictive models. The Brier score assessed the overall performance of the two models.
Results: The cohort included 107 polytrauma patients with a death rate of 10.3% at 72 hours since patient admission. The Trauma Pathway Explorer and TRISS showed similar AUCs to predict early death (AUC 0.90, 95% CI 0.79-0.99 vs. AUC 0.88, 95% 0.77-0.97; $p = 0.75$). The calibration of the Trauma Pathway Explorer was superior to that of TRISS (chi-squared 8.19, Hosmer-Lemeshow $p = 0.42$ vs. chi-squared 31.93, Hosmer-Lemeshow $p < 0.05$). The Trauma Pathway Explorer had a lower Brier score than TRISS (0.06 vs. 0.11).
Conclusion: The IBM WATSON Trauma Pathway Explorer showed equal results in discrimination as TRISS but outperformed in calibration. In addition to being able to provide a prediction of early death, this visual analytics tool for polytrauma patients can also show the quantitative flow of patient sub-cohorts through different events, such as coagulopathy, hemorrhagic shock class, surgical strategy and the above-mentioned outcome. Here, we can present an accurate and valid alternative to TRISS for predicting early death in polytrauma patients.

Stress related growth after severe trauma: Investigating long-term psychiatric outcomes and coping mechanisms 20+ years after injury

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Objective: There is limited research on the long-term psychiatric outcomes of severely injured patients. Those studies existing, focus on the negativ effects like post-traumatic stress disorder, anxiety and depression. Yet, also psychiatric improvements can be noticed in patients after severe trauma, mainly focused on stress related growth. In our study we investigated coping mechanisms in multiply injured patients at least 20 years after trauma.
Methods: 631 patients, who suffered a severe injury between 1971 and 1990 were contacted 20 or more years later. All patients were 3 to 60 years of age when injured and were attended to at the same institution. 36 questions inspired by the stress related growth scale (SRGS) and the post-traumatic growth inventory (PGI) were enquired via a questionnaire. Questions touched on 5 specific topics relating to growth: 1) relationships to others, 2) personal strengths, 3) appreciation of life, 4) new possibilities and 5) spiritual change. Each question quantified improvements in specific areas: Possible answers were „None at all", „some" and „a great deal".
Results: A total of 338 patients returned the questionnaire and could be included in our study. Gender distribution was 114 females (33,8%) to 223 males (66,8%). 96,5% of patients reported improvements regarding at least one of the 36 questions. Approximately a third of patients noticed distinct improvements regarding their relationship to others (29,2%) and their appreciation of life (36,2%). Furthermore, 32,5% of patients registered overall positive attitudes towards new possibilities. Referring to spiritual changes, only 20,5% of patients reported positive changes, while 55,7% reported no changes at all. Regarding personal strengths, 23,4% indicated overall positive changes compared with 35% indicating no changes at all.
Statistical analysis showed women to adapt significantly better ($p < 0{,}01$) in every aspect besides spiritual changes. Furthermore, we noticed weak positive correlations between positive changes and age at injury ($r = 0.26$) as well as injury severity ($r = 0.152$). We saw, however no correlation with general health.
Conclusion: 20 years after severe trauma, patients report improvements in their relationship with others, appreciation of life and attitude towards new possibilities. Such coping mechanisms, as results of stress related growth, should be identified and fostered in clinical practice.

Extremities, Hand and Spine

ORIF versus nailing for humeral shaft fractures: A meta-analysis and systematic review of randomised clinical trials and observational studies

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Objective: This meta-analysis aims to compare open reduction and internal fixation with a plate (ORIF) versus nailing for humeral shaft

fractures in terms of healing, complications, general quality of life and shoulder/elbow function.
Methods: PubMed/Medline/Embase/CENTRAL/CINAHL was searched for both randomised clinical trials (RCT) and observational studies comparing ORIF with nailing for humeral shaft fractures. Effect estimates were pooled across studies using random effects models and presented as weighted odds ratio (OR) or risk difference (RD) with corresponding 95% confidence interval (95%CI). Subgroup analysis was performed stratified by study design (RCTs and observational studies).
Results: A total of ten RCT's (525 patients) and eighteen observational studies (4906 patients) were included. The effect estimates obtained from observational studies and RCT's were similar in direction and magnitude. More patients treated with nailing required re-intervention (RD: 2%; OR 2.0, 95%CI 1.0 – 3.8) with shoulder impingement being the most predominant indication (17%). Temporary radial nerve palsy secondary to operation occurred less frequently in the nailing group (RD: 2%; OR 0.4, 95% CI 0.3 – 0.6). Notably, all but one of the radial nerve palsies resolved sponta-neously in each groups. Nailing leads to a faster time to union (mean difference: -1.9 weeks, 95%CI -2.9 – -0.9), lower infection rate (RD: 2%; OR: 0.5, 95%CI 0.3 – 0.7) and shorter operation duration (mean difference: -26 minutes, 95%CI -37 – -14). No differences were found regarding non-union, general quality of life, functional shoulder scores, and total upper extremity scores.
Conclusion: Nailing carries a lower risk of infection, postoperative radial nerve palsy, shorter operation duration, and time to union. Absolute differences, however, are small and almost all patients with radial nerve palsy recovered spontaneously. Satisfactory results can be achieved with both treatment modalities and both techniques have their inherent pros and cons.

Wide awake local anesthesia no tourniquet (WALANT) – a revolutionary improvement in hand surgery

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Objective: Wide awake local anesthesia no tourniquet (WALANT) hand surgery offers the opportunity to create a bloodless field without using an arm tourniquet. Lidocaine for anesthesia mixed with epinephrine for hemostasis is frequently used without concerns in the hand and finger. This is a major improvement for the patient and the surgeon in terms of patient comfort and having the opportunity to test the hand and finger function intraoperatively. The movement away from tourniquet surgery, which often requires sedation or general anaesthesia is one of the most significant recent advances in hand surgery.
Methods: A subcutaneous infiltration of a mixture (1:100'000) of lidocaine (1%) and epinephrine (buffered 10:1 with 8.4% bicarbonate) is done with a 27 G canula. The mixture is infiltrated wherever surgical dissection, k-wire insertion, or manipulation of fractured bones will occur. The local anesthetic results in an extravascular Bier block. The injection is done slowly from proximal to distal to minimize injection pain. After the last injection a minimum time of 30 minutes should be waited for maximal epinephrine vasoconstriction in the finger.
Results: In the beginning WALANT was only used for small procedures like trigger finger or carpal tunnel release. Meanwhile also major hand surgical procedures like finger fractures, flexor tendon repairs, tendon transfers, arthroscopies, arthroplasties and open triangular fibrocartilage complex (TFCC) repair are performed in WALANT. Even procedures like trapeziectomy have been described using wide awake hand surgery, which involves numbing the joint itself.
Conclusion: The use of WALANT is a proven safe technique that can be used in up to 95% of hand surgical procedures. The benefits for patients and surgeons are obvious. Patients prefer the technique because there are no side effects of opiates or sedation. The anesthetic risk is minimized. Time at hospital is reduced. Patients do not have to suffer tourniquet pain.
Surgeons prefer the technique because of the bloodless surgical field without tourniquet, the possibility of intraoperative testing of stability of prosthesis or fracture stabilization, strength of a tendon repair, the movement and gliding properties in the flexor tendon sheath after repair or testing the tension of tendon transfers. These are probably the reasons for the continuously growing popularity of this technique worldwide.

Treatment of humeral fractures with long PHILOS plates using a modified technique and approach avoids radial nerve palsy in the last 10 years

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Objective: Radialis paresis is a known complication of plate osteosynthesis of the proximal humeral shaft. There are major differences with regard to surgical approach and implant. The standard treatment is a lateral-lateral approach. Here, iatrogenic damage to the radial nerve is a relevant complication. In our institution, these fractures have been treated with an adapted procedure for about 10 years. A long Philos plate is inserted proximally via a deltoido-pectoral approach. The plate is first torqued distally by about 45°-90° and then lies anteriorly on the humerus. The distal screws can be placed via anterior stab incisions. The advantage of this technique is that the implant and approach respect the anatomical course of the radial nerve and it does not have to be manipulated in an open exploratory manner. The aim of the study is to demonstrate the effectiveness of the surgical technique in relation to iatrogenic radial nerve paresis in comparison to the literature.
Methods: We analysed patients with a proximal humeral shaft fracture who were treated at our clinic with a long torqued philos plate using the adapted surgical method over the last 10 years. The fracture, the occurrence of iatrogenic radial damage and biometric data of the patients were analysed retrospectively.
Results: We found a total of 59 patients who underwent surgery according to the above-mentioned scheme between 2010 and 2020. The average age was 70.1 (40-101) years. There were 44 women and 15 men. 2 patients had a preoperatively documented radial nerve damage. In 57 patients, no damage could be found in the radialis supply area both pre- and postoperatively. 2 patients died shortly after surgery, 6 patients were loss to follow up. 2 patients had a tear of the distal plate bearing (1 malcompliance/1 pseudarthrosis). Both had to be revised. In the remaining 47 patients (78%), the healing process was unremarkable.
Conclusion: The described treatment of the proximal humeral shaft fracture has been successfully practised at our clinic for 10 years. Most of the fractures healed without complications. Compared to the exploration of the nerve, this method respects the anatomical course of the nerve and shows in the retrospective analysis that no iatrogenic damage to the radial nerve occurred. Thus, the surgical method represents a valid alternative to the established implants and classical surgical treatments.

MIPO vs. nail for extra-articular distal tibia fractures and the effect of intra-operative alignment control

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Objective: Definitive treatment of distal extra-articular fractures of the tibia is challenging and both minimal invasive plate osteosynthesis (MIPO) and intramedullary nailing (IMN) are considered feasible surgical modalities with their own implant-specific merits and demerits. This retrospective study was designed to compare MIPO versus IMN in terms of fracture healing, complications, functional and radiological outcomes and to assess the efficacy of intra-operative alignment control in order to reduce the rate of malalignment after definitive fixation of distal extra-articular fractures of the tibia.
Methods: All consecutive adult patients with extra-articular distal meta- or diaphyseal tibia fractures that were treated in a level 1 trauma center in Switzerland between January 2012 and September 2019 either

with plating or IMN were included. Outcome measures included fracture healing, complications (infection, malalignment, subsequent surgeries), functional and radiological outcomes. Intra-operative alignment control encompassed bilateral draping of the lower extremities.
Results: A total of 135 patients were included out of which seventy-two patients (53%) were treated with MIPO and 63 patients (47%) underwent IMN. There was a significantly higher incidence of non-union for fractures treated with an IMN (13 (22%) vs. 4 (6%), $p = 0.037$). There was no significant difference between both groups in terms of rotational malalignment (4% vs. 9%) and angular malalignment (4% vs. 5%). The incidence of malalignment in both groups was lower than reported in literature. A significantly higher rate of infection was found after MIPO (13% vs. 6%, $p = 0.028$). No differences were found in subsequent surgeries or functional outcomes.
Conclusion: Both MIPO and IMN are reliable surgical techniques. IMN is associated with higher rates of non-union whereas MIPO results in a higher risk for infection. The incidence of malalignment was surprisingly low endorsing the utility of the intra-operative alignment control.

Cement augmentation for trochanteric femur fractures: A meta-analysis and systematic review of randomized clinical trials and observational studies

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Objective: To date, it is unclear what the clinical benefit of cement augmentation in fixation for trochanteric fractures is. The aim of this meta-analysis is to compare cement augmentation to no augmentation in fixation of trochanteric femur fractures in the elderly patients (>65 years) following low energy trauma.
Methods: PubMed/Medline/Embase/CENTRAL/CINAHL were searched for both randomized clinical trials (RCT) and observational studies comparing both treatments. Effect estimates were pooled across studies using random effects models. Subgroup analysis was performed stratified by study design (RCTs and observational studies). The primary outcome is overall complication rate. Secondary outcomes include re-operation rate, mortality, operation duration, hospital stay, general quality of life, radiologic measures and functional hip scores.
Results: A total of four RCT's (437 patients) and three observational studies (293 patients) were included. The effect estimates of RCTs were equal to those obtained from observational studies. Cement augmentation has a significantly lower overall complication rate (28.3% versus 47.2%) with an odds ratio (OR) of 0.3 (95%CI 0.1-0.7). The occurrence of device/fracture related complications was the largest contributing factor to this higher overall complication rate in the non-augmented group (19.9% versus 6.0%, OR 0.2, 95%CI 0.1-0.6). Cement augmentation also carries a lower risk for re-interventions (OR 0.2, 95%CI 0.1- 0.7) and shortens the hospital stay with 2 days (95%CI -2.2 to -0.5 days). The mean operation time was 7 minutes longer in the augmented group (95%CI 1.3-12.9). Radiological scores (lag screw/blade sliding mean difference -3.1mm, 95%CI -4.6 to -1.7, varus deviation mean difference -6.15°, 95%CI; -7.4 to -4.9) and functional scores (standardized mean difference 0.31, 95%CI 0.0-0.6) were in favor of cement augmentation. Mortality was equal in both groups (OR 0.7, 95%CI 0.4-1.3) and cement related complications were rare.
Conclusion: Cement augmentation in fixation of trochanteric femoral fractures leads to fewer complications, re-operations and shorter hospital stay at the expense of a slightly longer operation duration. Cementation related complications occur rarely and mortality is equal between treatment groups. Based on these results, cement augmentation should be considered for trochanteric fractures in elderly patients.

The spanning plate as an internal fixator in complex distal radius fractures – a prospective cohort study

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Objective: Minimal invasive temporary spanning plate (SP) fixation of the wrist has been described as an alternative treatment method in complex distal radius fractures (DRFs). The purpose of this study is to conduct an outcome analysis of all consecutive DRFs treated by SP fixation representing the so far largest published patient cohort outside the United States.
Methods: Indication for SP fixation included DRFs with severe metaphyseal comminution, radiocarpal luxation fractures with concomitant ligamentous injuries and very distal intra-articular fractures lacking the possibility of adequate plate anchoring. All consecutive patients undergoing SP fixation of DRFs were prospectively included in a single level I trauma centre between 01/01/2018 and 31/12/2020. Post-operative assessments included radiological, functional and patient-rated outcomes at a minimum of 12 months follow-up.
Results: In the mentioned timeframe, a total of 508 DRFs were treated operatively of which 28 underwent SP fixation. Average age was 58.1 years (range 22-95 years). The fracture type ranged from AO/OTA type B1.1 to C3.3 and included 8 fracture dislocations. SP removal was performed on average 3.7 months after the initial operation (range 1.4-6.5 months). The mean follow-up time was 14.5 months (range 12-24 months). Radiological evidence of fracture healing appeared on average 9.9 weeks (range 5-28 weeks) after the initial operation. One patient experienced oligosymptomatic non-union. Complications included 2 patients with tendon rupture and one patient with extensor tendon adhesions needing tenolysis at the time of plate removal leaving an overall complication rate of 12%. There was no implant failure and no infection. Mean satisfaction score was 8 (range 0-10) and mean visual analogue scale for resting pain was 0.9 (range 0-9). The mean PRWE score was 17.9 (range 0-59.5) and the mean DASH score was 16.6 (range 0-60.8). Grip strength averaged 23kg (range 4-74kg) amounting to 68% of the opposite side. Mean radial inclination, volar tilt and ulnar variance at 1 year were all within the acceptable limit predictive of symptomatic malunion.
Conclusion: The radiological, functional and patient-rated outcomes in this study are remarkably good considering the complexity of the included fractures. Therefore, this method represents a valuable alternative for the treatment of complex DRFs in selected patients.

Vessel

Temporary extracorporeal femoro-femoral crossover bypass to treat critical limb ischemia due to occlusive femoral transaortic microaxial left ventricular assist device – a novel technique and case series

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Objective: The Impella transaortic microaxial left ventricular assist device (MLVAD) bears the risk of severe ipsilateral limb ischemia due to its percutaneous insertion through the common femoral artery (CFA). As long as the MLVAD is required for cardio-circulatory support, treatment options are limited. Therefore, we developed a temporary extracorporeal femoro-femoral crossover bypass to restore and maintain perfusion of the affected leg.
Methods: From October 2018, we treated all patients with severe limb ischemia due to the MLAVD with a femoro-femoral crossover bypass. For comparison, a consecutive cohort of patients undergoing placement of the MLAVD between January 2011 and July 2019 was identified.

For those patients who experienced limb ischemia after Impella placement, data on age, gender, BMI and diabetes, underlying cardiac condition, duration of Impella pump in place, limb complications, limb salvage procedure, need for additional surgical procedure on the affected limb (e.g. fasciotomy) were recorded.
The primary outcome is the feasibility and safety of our percutaneously established extracorporeal femoro-femoral crossover bypass. As secondary outcomes, we report overall 30 day mortality and limb salvage rates.
Results: Between January 2011 and July 2019, 25 of 245 (10.3%) patients developed a severe ipsilateral limb ischemia following the MLVAD placement.
Until October 2018, 20 patients were treated conventionally (C-cohort) and since October 2018, five (consecutive) patients have been treated by an extracorporeal femoro-femoral cross over bypass (BP-Cohort).
Following the BP-procedure, an immediate improvement of the perfusion was seen in all patients. The bypass remained in place during a median of 5 days. Limb salvage was documented in 100% of our patients and 30 days mortality was 60% in both groups.
Conclusion: This is the first case series reporting on this novel technique. We demonstrated that the percutaneous creation of an extracorporeal femoro-femoral crossover bypass is feasible, safe and effective and should therefore be promoted in the future.

Transcarotid artery revascularization (TCAR) – first experience

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Objective: In transcarotid artery revascularization (TCAR) the carotid stent used to treat carotid artery stenosis is introduced via a cut-down to the common carotid artery (CCA). Stent placement is performed during flow reversal using an external shunt to the femoral vein. The advantages compared to transfemoral carotid stenting are that the risks of embolization from the aortic arch and origin of the arch vessels are avoided and that clamping of the common carotid artery allows complete flow-reversal during stent placement. TCAR was developed in 2015 and is extensively used predominately in the USA. To our knowledge, TCAR has until now not been used in Switzerland. We present our first experience with TCAR.
Methods: Retrospective analysis of consecutive patients.

Results: We treated 4 patients with TCAR from Dec 2019 to May 2020. All patients were male, median age was 66y. All had high-grade internal carotid artery (ICA) stenosis (3 asymptomatic, 1 symptomatic). All procedures were performed in a hybrid operation room. Technical success was achieved in 3 patients. In these patients there was no peri-interventional stroke or TIA and duplex sonography 6 months postoperatively showed a patent stent without restenosis. In the fourth patient previous attempted transfemoral stenting for symptomatic ICA-stenosis had failed because of a very tortuous CCA. During TCAR, puncture of the CCA was difficult because of atherosclerotic thickening of the vessel wall, furthermore the tip of the guidewire for insertion of the dedicated sheath into the CCA needed to be placed in the CCA rather than in the external carotid artery (ECA) because of ECA occlusion. This led to inadvertent crossing of the stenosis with the guide wire. The procedure was abolished and converted to a conventional carotid endarterectomy. The patient had a perioperative minor stroke with signs of embolization into branches of the medial cerebral artery. He underwent transfemoral intracranial thrombectomy and eventually recovered with only minor deficits.
Conclusion: Our first experience with TCAR confirmed that patient selection is important: A combination of atherosclerotic disease of the CCA and occlusion of the ECA, both in themselves only relative contraindications to TCAR, led to technical failure and perioperative stroke. With good patient selection TCAR could be performed safely.

Renal autotransplantation – reappraisal of an old technique

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Objective: Transplantation of the patient's own kidney into the iliac fossa has been described already more than 50 years ago, predominately for the treatment of renal trauma or peripheral renal artery aneurysms. The technique is however rarely used. We describe our experience with renal autotransplantation.
Methods: Retrospective analysis of consecutive patients.
Results: We performed renal autotransplantation in 3 patients from 2017-2019. The first patient was a 72y old male who had previously multiple stents placed in both renal arteries for renal artery stenosis and presented with a high grade in-stent stenosis of the right renal artery, complete occlusion of the left renal artery and left renal atrophy. The second patient was a 56y old male who presented with a 29mm aneurysm in the bifurcation of the left renal artery. The third patient was a 29y female with Takayasu disease, who had undergone endarterectomy of the abdominal aorta and vein bypass to the left renal artery as a child and stenting of the abdominal aorta for restenosis. She presented with aneurysmatic dilatation and high-grade restenosis of the vein bypass to the left renal artery. In the first two patients, laparoscopic nephrectomy via a retroperitoneal approach was performed as for living donor nephrectomy. The patient with the renal artery aneurysm had back table resection of the aneurysm and reconstruction by forming a common ostium of the two branch arteries. In the third patient, we explanted the kidney via laparotomy. In all patients, the kidney was perfused with cooled organ preservation solution after a brief period of warm ischemia and transplanted in the iliac fossa in standard fashion. After a median follow-up of 20 months (range 9-31) all autotransplanted kidneys showed good perfusion with no signs of renal artery stenosis. Median creatinine clearance was 97ml/min/1.7m2 (range 59-118).
Conclusion: Renal autotransplantation is a safe and durable procedure worth remembering when evaluating the treatment options of complex renal artery pathologies. Its use can also be envisaged for the treatment of complex renal trauma or complex ureter lesions.

Multicenter observational study of the gore excluder conformable endograft for endovascular abdominal aortic repair: Initial results

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Objective: Endovascular repair (EVAR) has become the standard of care for treatment of abdominal aortic aneurysms. However, a significant number of EVAR remains outside the IFU, especially in cases of severe proximal angulation (>60 degrees), resulting in failure. The new device GORE EXCLUDER Conformable AAA Endoprosthesis (W. L. Gore & Associates, Flagstaff, Ariz) has been designed to accommodate neck angulation, due to conformability and angulation control. The aim of this multicenter study is to report the initial results of this device.
Methods: From March 2019 to January 2021, the data of all consecutive patients with AAA treated with the Gore Excluder Conformable endograft at 4 vascular centers were reviewed. Patients were followed using a standardized protocol, with CT-scan at 1, 6 and 12 months, and then yearly. The primary endpoint was technical success and secondary outcomes were postoperative morbidity, rate of endoleak (EL) and any aneurysm-related re-interventions during follow-up.
Results: Among the 32 patients included, most were men with a mean age of 77 years old (range 60-92). Half of patients were smokers and 72% had hypertension. The mean diameter of AAA was 62 mm (47-90). The mean length of aortic neck was 26 mm (10-69), the mean diameter 23 mm (16-31) and the median neck angulation was 81 degrees (range 40-110). The mean procedural duration was 102 min (54-153) with a

mean time of scopy of 24 min (8-47) and a total volume of contrast of 101 ml (40-165). Thirteen iliac branch device have been used in 7 patients. The technical success was 97% with 1 type Ia EL (3%). In the post-operative period, 4 medical and 3 surgical complications were observed. Two reinterventions were needed with an iliac stenting for a stenosis and a correction of a femoral false aneurysm. During the mean follow-up of 7 months, 2 type Ia ELs were observed. One spontaneously resolved and the other one was followed. One distal limb extension was succesfully implanted at 3 months for a type Ib EL for a total rate of reintervention of 9%. No migration was observed. No death occured.

Conclusion: The use of the Gore Excluder Conformable endograft seems to be safe and effective in difficult anatomies and especially high angulation. It allows for precise deployment without the need for additional contrast or operation time. Longer follow-up and more patients are required to confirm these excellent initials results.

Protected and unprotected radiation exposure to the eye lens of vascular surgeons during endovascular procedures in hybrid operating rooms

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Objective: Radiation induced cataract has been observed at lower threshold doses than expected. Therefore, the annual limit for equivalent dose to the eye lens has been reduced from 150 to 20 mSv. We aimed to evaluate radiation exposure to the eye lens of vascular surgeons working in a hybrid operating room before and after a dose reduction program was established.

Methods: Prospective non-randomized trial with a historic control group. From April – October 2019, radiation exposure to the operator was measured during all endovascular procedures performed in the hybrid operating room using BeOSL Hp(3) eye lens dosimeters placed outside the 0.75mm lead equivalent glasses on the side of the radiation source and behind the lead glasses. Measured values were compared to data from a prospective study performed at the same center in the years of 2012 and 2013 before a dose reduction program had been implemented.

Results: A total of 181 consecutive patients underwent an endovascular procedure in the hybrid operating room. The mean unprotected eye lens dose of the main operator was 0.119 mSv for EVAR (n = 30), 0.118 mSv for TEVAR (n = 23), 0.312 mSv for more complex aortic procedures (F/BrEVAR; n = 15) and 0.046 mSv for peripheral interventions.
Compared to the control period, EVAR had 75% lower, TEVAR 79% lower and more complex aortic procedures 55% lower radiation exposure unprotected eye lens of the operator. The 0.75 mm lead equivalent glasses led to a median reduction of the exposure to the eye lens by the factor 3.43. Behind the lead glasses at the level of the eye lens, radiation exposure exceeding the detection limit of 0.042 mSv was measured only in 22 of 181 cases. There was a significant correlation between DAP between both protected and unprotected eye lens dose ($p < 0.0001$, r2 = 0.512 and 0.282). DAP correlated significantly with patients' body mass index, operating time, fluoroscopy time and digital subtraction angiography time.

Conclusion: The dose reduction program at our institution has led to a relevant reduction of the radiation dose to the head and the eye lens of the main operator in endovascular procedures. With optimum radiation protection measures including a ceiling-mounted shield and 0.75 mm lead equivalent glasses, more than 440 EVARs, 280 TEVARs or 128 FEVARs could be performed per year until the dose limit for the eye lens of 20 mSv would be reached.

Room staff radiation dose in a vascular surgery hybrid operating room and evaluation of a real-time radiation dosimeter

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Objective: Real-time radiation dosimeter have been shown to decrease radiation exposure of the staff. This effect is mainly explained by increased awareness of the radiation due to direct radiation exposure feedback to the operator. We aimed to measure the radiation exposure of all staff members working in a hybrid operating room and wanted to compare the equivalent doses of real-time radiation dosimeters with thermoluminescence dosimeters.

Methods: Prospective non-randomized comparative trial. From April – October 2019, all staff members working in a hybrid operating room were equipped with real-time radiation dosimeters (Unfors RaySafe i3). The table positions of all staff members were documented. In addition, the first operator was equipped with a thermoluminescence Hp(3) eye lens dosimeter (TLD) placed outside the lead glasses to validate the real-time radiation dosimeter.

Results: The median dose of the operator / the first assistant was 73.6 µSv / 21.8 µSv for EVAR (n = 30); 57.25 µSv / 18.2 µSv for TEVAR (n = 23); 207.0 µSv / 76.65 µSv for more complex aortic procedures (f/bEVAR etc.; n = 15); 14.85 µSv / 8.5 µSv for occlusive disease of the iliac arteries (n = 27) and 6.1 µSv / 3.4 µSv for occlusive disease of the peripheral arteries (n = 53). The anesthesiologist's median dose was 0.3 µSv, with highest values in f/bEVAR (3.9µSv). The scrub nurse's median dose was 2 µSv with highest values in f/bEVAR (24 µSv). The position of any staff member at the left arm for transbrachial cannulation in f/bEVAR was associated with higher median equivalent radiation doses compared to the right femoral position (272.5 vs. 207 µSv for the operator (p=ns), 175.3 vs. 27.8 µSv for the first assistant ($p = 0.027$) and 45.55 vs. 8.0 µSv for the scrub nurse ($p = 0.14$)). The equivalent doses of the TLD and RaySafe did not correlate well using simple lineal regression analysis (r2 0.1713, $p = 0.0014$).

Conclusion: With the RaySafe real-time radiation dosimeter, table positions with increased radiation exposure can be identified. This allows for improvement in shielding at these positions, possibly leading to lower radiation exposure of the staff.

In-hospital and mid-term outcome after complex endovascular aortic repair with fenestrated and branched stent-grafts

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Objective: The aim of the study is to evaluate in-hospital and mid-term outcome after complex endovascular aortic repair with fenestrated and branched stent-grafts (fEVAR / bEVAR).

Methods: This is a single-center retrospective analysis from a prospectively collected database of all patients treated electively with fEVAR or bEVAR for para/suprarenal (PAA) and thoraco-abdominal aortic aneurysm (TAAA) between September 2010 and June 2019. In-hospital and mid-term mortality, major adverse events and re-interventions were assessed.

Results: Fifty-one patient (84% male) with a mean age of 74±7 years were analysed. Eighteen patients (35%) had TAAA, four patients (8%) suprarenal, and 29 patients (57%) pararenal aortic aneurysms. Mean aneurysm diameter was 64±8 mm. Thirty-eight patients (75%) underwent fEVAR and 13 patients (25%) bEVAR. A total of 157 target vessels were incorporated: 22 celiac trunks (CT), 40 superior mesenteric arteries (SMA), 92 renal arteries (RA), two separate hepatic arteries and one splenic artery. No in-hospital death or stroke was recorded. One patient suffered from early postoperative paraplegia and did not recover and one had paraparesis after 38 days and recovered completely. Six patients (12%) with patent renal arteries experienced acute postoperative kidney injury; one required temporary dialysis. Five in-hospital re-interventions were stent-graft related (four bridging stents angioplasty

and one iliac leg extension) and seven re-interventions were not stent-graft related.
Mean follow-up was 19±17 months. Eleven patients (22%) died during follow-up: nine were not aortic-related and two were unknown. The Kaplan-Meier estimated survival rates at 1 and 2 years were 81% and 77%, respectively. Five renal stents (5%, 5/92) occluded during follow-up: three were successfully recanalized and two remained occluded. Ten stents (three CT, five SMA, and two RA stents required relining after 13±16 months postoperatively, resulting with estimated primary assisted patency at 2 years of 100%, 100%, 93%, and 95% for the CT, SMA, right RA and left RA, respectively.
Conclusion: Complex endovascular aortic repair with fEVAR / bEVAR for PAA and TAAA is safe with very low early mortality and morbidity. In-stent stenosis/occlusions occurred within the first two years. However, primary assisted patency was high. A surveillance program to detect potential stent-graft related complications is mandatory.

Outcome after cervical debranching for proximal landing zone extension in thoracic endovascular aortic repair

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Objective: Aim of this study was to assess perioperative and long-term outcome after cervical debranching for proximal landing zone extension in thoracic endovascular aortic repair (TEVAR).
Methods: Retrospective analysis of all patients undergoing left-sided carotid-subclavian bypass (CSB) and subclavian-carotid transposition (SCT) with simultaneous or staged TEVAR between 2010 and 2019. Endpoints were patency and re-intervention due to the debranching, postoperative stroke, cranial nerve injury and mortality at 30 days and during follow-up.
Results: Forty-eight patients (66 ± 12 years, 81 % male) had 25 (52%) CSB and 23 (48%) SCT. TEVAR was performed simultaneously in 39 (81%). Eleven (23%) patients had simultaneous emergency debranching and TEVAR. There were eight (17%) re-interventions within 30 days: four due to local hematoma, one for bypass occlusion, two for stenosis (of which one was not confirmed intraoperatively), and one after initially abandoned SCT with subsequent CSB on the next day. Thirty-day mortality was 2 %; one patient died on the first postoperative day after combined CABG surgery and multiorgan failure. Four (8%) patients suffered postoperative strokes; three occurred after simultaneous emergency procedures and none was fatal. Seven (15%) patients had postoperative ipsilateral cranial nerve lesions: two occurred after CSB and five after SCT. Two patients had recurrent laryngeal nerve palsy, two had phrenic nerve injury and three had Horner syndrome. All patients had mild symptoms and recovered mostly.
During a mean follow-up of 31±29 months with a Follow-up Index of 0.77, there were no reinterventions or occlusions, and no graft infections. Primary patency was 94%, primary assisted patency 96%, and secondary patency 100%. 9 patients died during follow-up after a mean of 30±29 months (range 0-82) all of them with patent cervical debranching.
Conclusion: Cervical debranching for proximal landing zone extension in TEVAR is a safe procedure with an acceptable rate of early re-interventions. There is a higher risk for postoperative stroke during simultaneous emergency debranching and TEVAR. Cranial nerve injuries and hematomas remain relevant periprocedural complications. During follow-up, excellent patency can be expected.

Patient-specific computational fluid dynamic simulation for assessing hemodynamic changes following branched endovascular aneurysm repair: A pilot study

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Objective: This pilot study assessed the hypothesis that patient-specific computational fluid dynamic (CFD) modelling can detect aortic branch hemodynamic changes following branched endovascular aneurysm repair (bEVAR).
Methods: Patients who underwent bEVAR with the Jotec E-xtra Design for thoracoabdominal aortic aneurysms were retrospectively selected. Using open-source SimVascular software, pre- and post-operative aortic finite element volume meshes were constructed from CT imaging. Pulsatile in-flow conditions were derived and adjusted for patient-specific clinical variables. Outlet boundary conditions consisted of Windkessel models approximated from physiologic flow splits. Rigid wall flow simulations were then performed on pre- and post-operative models with equivalent boundary conditions. Computations were performed with an incompressible Navier-Stokes flow solver on a 72-core cluster.
Results: Pre- and post-operative flow simulations were performed on 10 patients undergoing bEVAR with a total of 40 target vessels (10 celiac, 20 superior mesenteric, 20 renal stents). Compared to pre-operative values, bEVAR was associated with a decrease in peak renal artery pressure (116.8 ± 11.5 vs 112.8 ± 11.6 mmHg, $p<.001$) and flow rate (13.7 ± 2.3 vs 12.9 ± 2.4 ml/s, $p<.001$). No post-operative differences were observed in pressure or flow rates in the celiac or mesenteric arteries ($p=.10$-$.55$). Representative perfusion waveforms from a single patient are shown in Figure 1. bEVAR resulted in a significant increase in aortic (1.4 ± 0.5 vs 4.3 ± 2.9 dynes/cm2, $p=.009$) and renal artery (24.3 ± 7.1 vs 35.4 ± 12.4 dynes/cm2, $p=.23$) wall shear stress; however, these values remained within the physiologic range. In certain graft configurations, 3D visualization of blood flow streamlines revealed areas of turbulent flow at the origin of external branches which were associated with decreased target artery perfusion (Figure 2).
Conclusion: Changes in para-visceral aortic geometry after bEVAR is associated with a decrease in computationally estimated renal perfusion, without significant changes to celiac or mesenteric hemodynamics. Further CFD simulation-based studies are needed to assess whether changes in branch configuration or hemodynamics after bEVAR can predict loss of branch patency.

Outcome after acute und subacute TEVAR in uncomplicated type B aortic dissection

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Objective: In the past years, a paradigm shift from best medical therapy to early thoracic endovascular aortic repair (TEVAR) has been observed in the treatment of uncomplicated type B aortic dissection (uTBAD). We aimed to analyze outcomes after TEVAR in the acute and subacute phase of uTBAD, focusing on aortic remodeling.
Methods: Retrospective analysis of consecutive patients who underwent TEVAR for acute or subacute uTBAD in two tertiary referral centers from 2008 – 2017. Two assessors per center reviewed computed tomography scans of each patient at presentation, at one year and at the last follow-up using post-processing software.
Results: Forty-nine patients were treated with TEVAR for uTBAD. The indication for TEVAR was the presence of multiple morphologic predictors of adverse aortic outcome. The most common predictors were a false lumen diameter of >= 22mm in 76% of patients, a primary entry tear of >= 10mm in 69% and a total aortic diameter of >= 40mm in 67%. There were no in-hospital deaths and no deaths at 1 year. The median follow-up was 40.6 months. Three-year cumulative survival was 94 % (46/49). Fourteen secondary interventions were performed in 10 patients (20 %) after a median of 4.2 months. TEVAR lead to remodeling of the descending thoracic aorta with a median reduction of the total aortic diameter of 4.5 mm within one year and stable diameters after three years. The median maximum false lumen diameter diminished from 26 mm to 15 mm in one year (at 3 years: 14.8 mm).
Conclusion: In this cohort of selected patients with uTBAD and multiple morphologic predictors of worse aortic outcome, elective acute or subacute TEVAR was associated with a low mortality and positive aortic remodeling in the mid-term follow-up.

Early-cannulation arteriovenous grafts are safe and effective in avoiding recurrent tunneled central catheter infection

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Objective: Tunneled central venous catheter infection (TCVCi) is a common complication that often necessitates removal of the TCVC and a further TCVC. Theoeretically, insertion of an early-cannualtion graft (ecAVG) early after TCVC infection is possible but not widely practiced with concerns over safety and infection in the ecAVG. With 8 years of ecAVG experience, the aim of this study was to compare the outcomes following TCVC infection, comparing replacement with TCVC (TCVCr) versus immediate ecAVG (ecAVGr).
Methods: Retrospective comparison of two cohorts, who underwent replacement of an infected TCVC either by an early cannulation graft ($n = 18$) or by a further central catheter ($n = 39$).
Data were abstracted from a prospectively completed electronic patient record and collected on patient demographics, TCVC insertion, duration and infection, including culture proven bacteriaemia and subsequent access interventions.
Results: 18/299 patients identified from 2012-2020 had an ecAVG implanted as treatment for a TCVCi. In a one-year time-period (1/1/2015 -31/12/2015) out of 222 TCVC inserted, 39 were as a replacement following a TCVCi. No patient with an ecAVGr developed an immediate infection, nor complication from the procedure. The rate of subsequent vascular access infection was significantly more frequent for those with TCVCr than with an ecAVGr (0.6 vs. 0.1/patient/ 1000 HD days, $p < 0.000$). The number of further TCVC required was significantly higher in the TCVCr group (7.1 vs. 0.4/patient/ 1000 HD days, $p = 0.000$).
Conclusion: An ecAVG early following a TCVC infection is safe, reduces the incidence of subsequent infectious complications and reduces the number of TCVC required, with a better functional patency.

First experience with percutaneous arteriovenous fistula creation using the Ellipsys® vascular access system

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Objective: Percutaneous creation of arteriovenous fistulae (pAVF) has been developed as an alternative to the creation of an upper arm cephalic or basilic vein fistula. Several studies have shown high technical success rates and comparable time of maturation. To our knowledge, the technique has not been used in Switzerland before.
Methods: Prospective data collection of the first consecutive patients undergoing the creation of pAVF between April and July 2020 at two vascular surgery centres.
Results: Seven patients underwent pAVF creation with the Ellipsys® vascular access system under regional anaesthesia for maximum vasodilation. The procedures were performed entirely under sonographic control without the use of fluoroscopy. The cephalic or basilic vein was punctured and the puncture needle advanced under sonographic control through the cubital perforator vein into the proximal radial artery. The Ellipsys® catheter was advanced over a guidewire and activated to create the fistula between the proximal radial artery and the perforator vein. The fistula was further dilated with a 5mm PTA balloon. We achieved technical success in 6 patients. In one patient with small and spastic vessels, the needle could not be advanced into the radial artery. A conventional upper arm cephalic fistula was created during the same procedure. In three patients primary maturation was achieved and the cephalic vein or distal basilic vein could be punctured for dialysis without any adjunct procedures. One patient required three additional procedures before the fistula could be used successfully (additional angioplasty of the fistula, superficialisation of the basilic vein and correction of a cubital vein stenosis by excision and end-to-end anastomosis). One patient required superficialisation of the basilic vein and one patient transposition of the arterialised brachial vein. Maturation was achieved in six pAVF after a mean of 158 days with a mean fistula flow of 920 ml/ min.
Conclusion: We achieved high technical success and maturation rates in our first patients undergoing pAVF creation with the Ellipsys® system. Prerequisites are suitable anatomy of the cubital perforator vein and good skills in sonography and endovascular techniques. We believe that pAVF is a promising alternative to the creation of a conventional upper arm fistula in patients unsuitable for a distal radiocephalic fistula.

Tele-proctoring in vascular surgery implementing percutaneous creation of arteriovenous fistula

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Objective: Percutaneous ultrasound-guided creation of an arteriovenous fistula (pAVF) for hemodialysis access is a relatively novel procedure with promising technical success and patency rates. The vascular surgery departments of two collaborating Swiss hospitals had decided to introduce the technique to their services. A surgeon experienced in the technique (AM) was supposed to come to Switzerland and proctor the first four procedures. Due to the SARS-CoV-2 pandemic and travel restrictions, this was not possible and we decided to perform the first four pAVF procedures tele-proctored via a video conference system. We present the setup and our experience with tele-proctoring.
Methods: The setup relied on an all-in-one live video production device, video encoder, video streamer and video recorder (Pearl-2, Epiphan), which made it possible to simultaneously transmit the live image from the ultrasound device (GE Logiq S8, linear probe 9L-D) and a live image from a video camera (JVC Camcorder G/-HM440E, Japan), both connected via HDMI (Figure). The live stream was shared with the proctor in France and the device support team in the US, using an encrypted Swiss video client (www.vitimway.ch). The setup was tested with all parties three days in advance.
Results: All 4 procedures started with a verbal briefing and a live ultrasound scan. All steps of the procedures were taken under the proctor's instruction and supervision. The proctor gave on average 21 instructions per procedure. An average 4 were device-related but these became less frequent as we proceeded. The operators consulted the proctor on average 5 times per procedure. The average duration of the procedure was 34 min. The pAVF creation was successful in all 4 patients, with an average fistula flow measured at the end of the procedure of 600 ml/min.
Conclusion: Our experience showed us that pAVF creation, which is a procedure performed entirely under sonographic guidance lends itself particularly well to tele-proctoring. The simultaneous transmission of the live sonographic image and the live image of the operators' hands allowed the proctor to supervise and correct the key steps of the procedures. The simplicity of the set-up and the quality of proctor-operator interaction was such a positive experience that we can well envisage a much wider use of tele-proctoring in the future.

Thorax

VE/VCO2 slope predicts short- and long-term outcome after anatomical pulmonary resection by VATS

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Objective: The ventilation-to-carbon dioxide output (VE/VCO2) slope could predict morbidity and mortality after lung resection. The aim of the study was to identify whether VE/VCO2 slope obtained from cardiopulmonary exercise test (CPET) was an independent predictor of cardiopulmonary complications after anatomical pulmonary resection by video-assisted thoracic surgery (VATS).
Methods: We reviewed the files of all consecutive patients that underwent pulmonary anatomical resections by VATS between January 2010 and October 2020. The data were extracted from the registry of the Centre for Thoracic Surgery of Western Switzerland. Pneumonectomies were excluded from the study. We used a multivariable Cox regression to investigate the risk of cardiopulmonary complications associated with the VE/VCO2 slope and other possible confounders, including the Charlson Comorbidity Index (CCI), the CPET data and pulmonary functions.
Results: In total, 1392 patients (mean age: 66±11 years; ratio female: 47%) underwent anatomical resection by VATS. CPET was performed in 204 patients (15%). However, the VE/VCO2 slope data were available in 145 patients, which were included for the analysis. Patients underwent segmentectomies (N = 42) and lobectomies (N = 101) mainly for lung cancer (96%). The average percentage of the predicted VO2max was of 70±17%. Maximal effort during the CPET (respiratory coefficient ratio >1.1) was not reached in 30% of patients, without impact on the VE/VCO2 slope (39±6 vs 37±7, P = 0.21). Cardiopulmonary complications appeared in 32% of patients with no mortality at 90 days. In the multivariate analysis, VE/VCO2 slope >35 was correlated with cardiopulmonary complications (OR 3.5, 95% CI [1.3-9.3], P = 0.012). CCI, pulmonary functions, peak VO2 and the extension of the anatomical resection was not associated with cardiopulmonary complications.
Conclusion: VE/VCO2 slope above 35 predicts postoperative cardiopulmonary complications in anatomical resections by VATS. The VE/VCO2 slope is independent of the intensity of effort during the CPET. The impact of prehabilitation on the slope should be determined.

Objective performance assessment on trainees of a VATS simulation program: A prospective single center study

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Objective: A prospective single center study to assess the objective impact on motion performance of a VATS simulation program on thoracic surgery trainees.
Methods: We developed a 6-month VATS simulation training program including exercises of progressive complexity on 3 different black box simulators: a 2D and 3D lobectomy model (Stupnik®) and a 3D perfused lobectomy model (Crabtree®). Between November 2019 and 2020, all consecutive thoracic surgery residents (study group) were prospectively enrolled in this weekly training program that was supervised by a board certified thoracic surgeon. We compared an objective performance evaluation of the study group before and after the training program by assessing movement parameters (distance in cm, time in sec) and absence of shock/extreme motion (%) on 3 simple standardized thoracoscopic exercises (peg placement on a board, rope insertion in loops and precision circle cutting) using the Simball®. Also, we determined the objective performance 6 months apart of 5 final year medical students (unexperienced controls) that were not trained.
Results: There were 7 residents (2 female and 5 male, median age: 29 [range: 26-34] years) who completed the 6-month VATS simulation training program. Five residents were in their first year while two had >3 year experience. The study group's objective performance improved significantly for all three movement parameters in all standardized exercises (Figure 1) after the training program. The objective performance of the unexperienced control group was comparable to the study group before training, but it remained unchanged at 6 months ($p > 0.05$). When comparing unexperienced and advanced residents, we observed that the training program had more impact on improving the performance for unexperienced residents ($p < 0.05$).
Conclusion: This study suggests that the implementation of a VATS simulation training program improves the objective performance of trainees compared to controls. Such programs could be interesting adjuncts for residents.

Is faster better? Impact of operative time on postoperative outcomes after VATS anatomical pulmonary resection

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Objective: Video-Assisted Thoracic Surgery (VATS) is now the preferred approach for standard anatomical pulmonary resections. However, operative time (OT) for this technique is correlated to many aspects, such as the surgical complexity or the surgeon's experience and skills. The aim of this study was to identify the factors associated with prolonged OTs and to assess the impact of OT on the development of post-operative complications after VATS anatomical pulmonary resections.
Methods: Retrospective monocentric study including all consecutive patients undergoing a VATS anatomical pulmonary resection for benign or malignant lesions between January 2010 and December 2019. Postoperative outcomes were compared between short (<150 minutes) and long (≥150 minutes) OTs. A multivariate analysis was carried out to identify predictors of longer OTs and post-operative complications.
Results: A total of 836 patients underwent a VATS anatomical pulmonary resection for malignant (n = 767, 91.7%) or benign (n = 69, 8.3%) lesions. Lobectomies were performed in 555 (66.4%), segmentectomies in 250 (29.9%), sleeve lobectomies in 16 (1.9%), bilobectomies in 11 (1.3%) and pneumonectomy in 4 (0.5%) patients. The conversion rate to thoracotomy was 7.7%. Of those 836 patients, 495 (59.2%) were operated within 150 minutes. During the 30-postoperative day period, the overall morbidity was significantly lower in the short OT group (29.1% vs. 40.5%; $p = 0.001$). Both the duration of drainage (3 vs. 4 days; $p < 0.00001$) and the length of hospital stay (6 vs. 7 days; $p < 0.00001$) were significantly reduced in the short OT group. Two predictors of long OT were identified on multivariate analysis: male sex (OR 1.41, $p = 0.04$) and neoadjuvant chemotherapy (OR 3.46, $p = 0.003$). A long OT was identified as an individual predictor of postoperative complications (OR 1.84, $p < 0.0001$).
Conclusion: A prolonged OT is an individual risk factor for postoperative complications in patients undergoing VATS anatomical pulmonary resection.

Management of malignant pleural effusion. A retrospective study comparing efficiency and outcomes of VATS talcum pleurodesis, insertion of tunneled pleural catheter (PleurX®), and a combination of both

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Objective: The management of malignant pleural effusion is a common problem in thoracic surgery. Patients are often polymorbid and are usually referred at a terminal stage of their oncological disease. Our objective was to compare the efficiency and outcomes after different treatment strategies of malignant pleural effusion.
Methods: We retrospectively reviewed the charts of a total of 416 patients treated during the period of 2010 to 2020 who underwent thoracoscopic pleurodesis with or without implantation of tunneled pleural

catheter (TPC) as well as patients who underwent the implantation of TPC alone. Primary outcome was postoperative survival and secondary outcome was length of stay (LOS). In addition, we documented the recurrence of ipsilateral pleural effusion and the need for reintervention as well as the pulmonary reexpansion of the lung on postoperative chest x-ray. Inclusion criteria were malignant pleural effusion and documented follow-up until time of death. Exclusion criteria were treatment for mesothelioma, pneumothorax and emphysema.

Results: A total of 199 patients were included for analysis. Median LOS of patients treated with implantation of TPC alone in analgosedation (n = 28) was 1 day (range:1-4 days). Median LOS of patients who received video-assisted talcum pleurodesis (n = 65) without implantation of a TPC was 6 days (range 1-38 days). Median LOS of patients who received VATS talcum pleurodesis and TPC (n = 106) was 3 days (range 1-34 day). The difference in LOS was statistically significant ($p < 0.05$). Median overall survival was 108 days (range 3-3001 days). There was no statistically significant difference in survival between the different treatment groups ($p = 0.47$).

Conclusion: The primary goal when treating patients with malignant pleural effusion is relief of dyspnea and/or pain and to keep the duration of the inpatient treatment to a minimum. In patients with a considerable surgical risk due to comorbidities and their underlying oncological disease and who don't require the sampling of histological material, a conservative treatment option with implantation of a TPC can be sufficient. The additional insertion of a TPC not only reduces the length of stay, but also has a positive effect on the efficacy of the pleurodesis in terms of less recurrence. We therefore recommend the routine use of TPC when performing VATS talcum pleurodesis in patients with malignant pleural effusion.

First results of spatial reconstruction and quantification of COVID-19 chest CT infiltrates using lung CT analyzer and 3D slicer

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Objective: Lung CT scans are early diagnostic tests in evaluation of COVID-19 patients. Data are usually analyzed visually and the extent of infiltrations can only roughly be estimated. The aim of the present study was to create a software to spatially visualize and quantify infiltrated and collapsed areas in lung CT scans and set these volumes into relation with non-affected lung areas.

Methods: A new software "Lung CT Analyzer" (LCTA, 1) was created from scratch in an international team-effort within the 3D medical imaging software 3D Slicer (2). LCTA consists of two components: "Lung CT Segmenter" implements an intuitive and semiautomatic workflow for the generation of lung masks. LCTA then uses masked thresholds of Hounsfield units to detect non-affected versus affected (emphysematous, infiltrated, and collapsed) areas of the lung. Intrapulmonary vessels are subtracted from the other volumes. Segment volumes are expressed in milliliters and displayed in 3D. COVID-Q was defined as affected divided by non-affected volume and can be calculated separately for both lungs.

3D Slicer and LCTA are open source, freely available and maintained on Github.

Results: CT data of twelve patients with moderate to severe COVID-19 (9 m, 3 f) were selected for the present retrospective study. All scans were performed shortly after admission. Thresholds of Hounsfield units (HU) for areas of interest were defined prior to the study and processing was identical for all patients. The median time effort for 3D reconstruction was 8 minutes per patient. For more detailed results please see the enclosed table. A 3D Slicer demo data set (Control) has been included for comparison.

Conclusion: The COVID-19 pandemic promoted fast-paced innovations such as LCTA in our hospital. LCTA was feasible, reproducible and easy to perform. COVID-Q correlated with COVID-19 lung involvement in all cases. All fatal cases showed COVID-Q values of > 2.0.

LCTA enabled the serial 3D reconstruction of infiltrated and collapsed lung areas in lung CT scans. The procedure may be of great help in the future analysis of pulmonary infiltrates of any cause. In COVID-19 disease, volumetric lung CT reconstruction could result in the definition of new prognostic factors, identify patients "at-risk" in the ICU, and be useful for follow-up.

(1) Lung CT Analyzer: https://github.com/rbumm/SlicerLungCTAnalyzer

(2) 3D Slicer: http://slicer.org

Chest wall stabilization and rib fixation using a nitinol screwless system in selected patients after blunt trauma: Long-term results in a single-center experience

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Objective: First experience with rib fixation by use of nitinol in terms of reliability, morbidity, influence on pain control and quality of life in a large series of selected patients after blunt chest trauma.

Methods: Data of all patients who underwent rib fixation by use of nitinol were retrospectively analyzed in terms of indications, morbidity and in-hospital mortality. Standard clinical and radiological follow-up was performed at 1, 3, 6, 12 months after discharge. Short-, mid- and long-term pain status and health related quality of life (HRQOL) were assessed using visual analogous scale (VAS) and short form 12 (SF-12) questionnaire.

Results: From September 2017 until April 2019, 70 patients underwent rib fixation by use of the nitinol device, consisting of dislocated and painful fractures (67.1%), pseudarthrosis (15.7%), emergencies with hemodynamical instability (8.6%), and flail chest (8.6%). Morbidity was 21.4% without wound infection; in-hospital mortality was 2.9%. Fracture of the material occurred in 5.7% of the patients during the first year but removal of the material was not necessary. Analysis of the pain score showed a decrease of the pain with a statistical significance for the whole collective and in the group with series of dislocated fractures ($p < 0.001$, linear mixed-effects models). Assessment of HRQOL revealed a significant improvement of the physical and mental score for the mid- and long-term analysis.

Conclusion: Our results suggest that rib fixation with nitinol device is reliable, associated with an acceptable morbidity, and significantly decreases pain and improves health related quality of life.

Nicotinamide Adenine Dinucleotide (NAD+) improves lung function in rat lung ex-vivo lung perfusion model

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Objective: Ischemia-reperfusion injury compromises short- and long-term outcome after lung transplantation. The scarce existing data on the natural co-enzyme NAD+ suggest an antagonistic effect on hypoxia induced vasoconstriction, removal capacity on reactive oxygen species, and anti-inflammatory effects. We therefore investigated the impact of NAD+ on ischemic rat lungs during ex-vivo lung perfusion (EVLP).

Methods: Lungs were retrieved from 12 outbred Sprague Dawley male rats and exposed to 14 hours of cold ischemic storage. All lungs were then perfused in a rat EVLP system for 4 hours. Lung grafts were injected after 1, 2 and 3 hours with 2000 uM NAD + (N = 6) or placebo (N = 6) in the perfusate in proximity of the pulmonary artery. EVLP physiology and biochemistry were monitored.

Results: During the 4 hours of EVLP, the lung function increased significantly in the NAD+ group when compared to the placebo group. We monitored a higher vascular flow ($p = 0.018$), a lower mean pulmonary pressure ($p = 0.007$) and increased oxygenation capacity ($p = 0.003$). Lung compliance and weight were comparable. Tissue inflammation measured by myeloperoxidase was significantly lower in the NAD+ group ($p = 0.015$). In the perfusate, we observed in the NAD+ group significantly lower levels of pro-inflammatory interleukin-18 ($p = 0.033$) and a trend towards high levels of anti-inflammatory interleukin-10 ($p = 0.080$) and low levels of pro-inflammatory interleukin-12 ($p = 0.146$).
Conclusion: Findings from this preliminary study demonstrated that NAD+ is a promising agent with both anti-inflammatory properties and the ability to improve ischemic lung function. This observation should be validated in a large animal model.

Basic Research

Platelet-induced cell signaling during liver regeneration

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Objective: To investigate the mechanisms driving the interaction of platelets with liver sinusoidal endothelial cells (LSEC) during liver regeneration.
Methods: Platelets were tracked in vivo in mice by intravital confocal microscopy after partial hepatectomy. In vitro, we isolated highly pure mouse LSEC and analyzed their interactions with platelets, hepatic stellate cells (HSC), Kupffer cells and hepatocytes.
Results: Recruited platelets adhered to LSEC in vivo within the remnant liver segments following partial hepatectomy and were necessary for the interleukin 6 (IL-6) burst that occurred afterwards. In vitro, platelets were activated after incubation with LSEC and released transforming growth factor β1 (TGF-β1), which stimulated LSEC to secrete IL-6 (fold increase of 9.8 ± 0.73 relative to baseline). Antibody-mediated neutralization of TGF-B1 or its downstream SMAD signalling pathway prevented the effects of activated platelets on LSEC.
We also demonstrated that IL-6 released by LSEC stimulates HSC to produce hepatocyte growth factor (HGF) a main mitogen for hepatocytes.
Conclusion: Our results suggest that after hepatectomy, platelets initiate liver regeneration by interacting with LSEC and stimulate IL-6 release, which in turn stimulates HSC to produce HGF.

Hydrogen sulfide (H2S) reduces oxygen and ATP consumption in the isolated perfused pig kidney

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Objective: Organ donation after circulatory death [DCD] has the potential to reduce the shortage of kidneys available for transplantation. However, many DCD grafts are discarded because of long warm ischemia times. Strategies reducing oxygen demand may minimize damages caused by ischemia/reperfusion injury. Ex-vivo, Hydrogen sulfide (H2S) reduces oxygen and ATP consumption of the isolated perfused kidney, reduces inflammation and improves renal function following ischemia reperfusion injury in rodents. However, the benefits and applicability of H2S in clinically relevant model remain unknown.
Methods: To mimic DCD, pig kidneys underwent 0 or 60 min of warm ischemia, before oxygenated hypothermic machine perfusion (HMP). NaHS (100μM), an H2S donor, was added to the perfusion media or injected as an intra-arterial bolus before warm ischemia. After 2 hours of HMP, kidneys were transplanted and reperfused for 1 hour before harvest. Kidney function was assesses before, after and during ex vivo perfusion by measuring energy metabolites, Gadolinium elimination by pMRI and histopathological scoring.
Results: Warm ischemia (60 min) induced significant histological damages, delayed cortical and medullary Gadolinium elimination (perfusion), and reduced ATP levels, but not its precursors (AMP). As expected, ATP levels and kidney perfusion both inversely correlated

with the severity of kidney histological injury. NaHS reduced metabolism during warm ischemia, and seemed to increase kidney ATP levels and viability after reperfusion.

Conclusion: Our preliminary data suggest that the H2S donor NaHS reduces kidney metabolism and protects from warm ischemia. Further experiments will identify the best administration protocol and the clinical relevance of H2S supplementation in the context of organ preservation.

Ex vivo analysis of graft viability using 31P magnetic resonance imaging spectroscopy

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Objective: Expansion in organ supply has been proposed through the use of organs after circulatory death (donation after circulatory death [DCD]) in order to face the chronic shortage of kidneys for transplantation. However, many DCD grafts are discarded because of long warm ischemia times, and the absence of reliable non-invasive means to determine kidney viability. P magnetic resonance imaging (pMRI) spectroscopy is a noninvasive method to detect high-energy phosphate metabolites, such as ATP. However, the reliability of pMRI to predict kidney energy state, and its viability before transplantation remain also unknown.

Methods: To mimic DCD, pig kidneys underwent 0, 30 min or 60 min of warm ischemia, before oxygenated hypothermic machine perfusion (HMP). During the ex vivo perfusion, we assessed energy metabolites and Gadolinium elimination using pMRI. Each sample underwent histopathological scoring.

Results: Using pMRI, we found that in pig kidney, ATP was rapidly generated in presence of oxygen (100 kPa), which remained stable up to 22 h. Warm ischemia (60 min) induced significant histological damages, delayed cortical and medullary Gadolinium elimination (perfusion), and reduced ATP levels, but not its precursors (AMP). Finally, ATP levels and kidney perfusion both inversely correlated with the severity of kidney histological injury.

Conclusion: ATP levels, and kidney perfusion measurements using pMRI, are biomarkers of kidney injury after warm ischemia. Future work will define the role of pMRI in predicting kidney graft viability and patient's survival.

Optimal liver metabolism and proliferation require the tight junction protein claudin-3

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Objective: The expression of hepatic tight junction proteins and their contribution to homeostasis and regeneration remained largely unexplored. Here, we determine the cell type specific expression of tight junction genes in murine livers. We further explore the regulation and functional importance of the transmembrane protein CLDN3 in normal and regenerating livers.

Methods: Murine livers were used for tissue- and single cell RNA-seq. CLDN3 localization was determined by immunofluorescence. CLDN3+/+ or CLDN3-/- livers were analysed by electron microscopy, fluorescence-activated cell sorting and liquid chromatography mass spectrometry. Lipid content was quantified with oil-red. Mice were subjected to 2/3 partial hepatectomy. Proliferation was quantified with Ki67 and pHH3 stainings. Cell cycle gene expression was determined by RT-qPCR. Barrier impairments were assessed with total bile acid measurements. Differential gene expression was analysed by tissue RNAseq with DESeq2.

Results: We determined the profile of tight junction gene expression the main liver cell types, showing that tight junction transcripts can be found in hepatocytes and cholangiocytes but also on non-parenchymal cell populations. CLDN3 was among the highly expressed- and regulated genes in native and regenerating livers. CLDN3 had a zonated expression pattern. CLDN3-/- mice had microscopically intact tight junctions, but showed significantly downregulated hepatic energy metabolism and suboptimal cell proliferation in the regeneration model.

Conclusion: Our data suggests a functional role of CLDN3 for maintenance of energy homeostasis and optimal regeneration, proving that the function of hepatic tight junction proteins extends beyond basic membrane sealing.

Maternal metabolic syndrome induces liver injury and promotes tumor growth in the offspring

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Objective: Obesity is a growing disease entity affecting a third of women of reproductive age. Epidemiological studies show that children of obese mothers suffer from obesity, long-term morbidity and an increased rate of childhood cancers. However, the mechanisms of disease transmission remain unknown. The aim of this study is to test this hypothesis in a mouse model and shed light on the involved mechanisms of vertical transmission.

Methods: Female mice were fed a high fat or standard diet (HFD/SD) for 16 weeks before being mated with mice fed a normal diet. Corresponding diet was continued until weaning, all offspring were thereafter fed a SD. Metabolic profile, weight gain, liver enzymes and the gut microbiota profile were assessed in the offspring ($n = 24$). Additional groups of offspring ($n = 48$) were injected with a carcinogen (diethylnitrosamine) at week two, tumor characteristics were assessed by computed tomography scan at week 36.

Results: Mothers fed HFD developed obesity and non-alcoholic fatty liver disease (NAFLD). Female offspring of mothers fed HFD gained significantly more weight (+33.7%, $p = 0.001$), had increased alanine transaminase levels (62 vs 18 IU/L, $p = 0.003$) and a significantly altered liver histology exemplified by an increased NAFLD activity score (3.8 vs 0.6, $p = 0.016$). Expression levels of several candidate genes were studied of which FGF21 showed the largest differential expression between HFD and SD offspring (9 vs 1 $2^{\Delta\Delta CT}$, $p = <0.001$). However, epigenetic analysis of FGF21 in the liver revealed no changes in methylation level between HFD and SD offspring. Furthermore, offspring of HFD mothers had a distinctly altered gut microbiome with lower proportions of Bacteroides caccae, Bacteroidales and Parasutterella excrementihominis. Interestingly, the proportion of female offspring developing tumors was significantly higher in offspring of HFD mothers (83 vs 44%, $p = 0.011$), the average total tumor volume was larger (234 vs 3.5mm3, $p = 0.022$) and the offspring developed more tumors (3.5 vs 0.6, $p = 0.010$).

Conclusion: Maternal obesity promotes liver tumor growth in the offspring, alters metabolic patterns and induces liver suffering in the progeny in a sex-dependent manner. The gut microbiome seems to play a role in this transmission of disease. Yet further research is needed to determine the vectors of transmission and evaluate preventive interventions in obese mothers.

Modulating hepatocarcinogenesis by porto-systemic vein shunting in a high-fat diet mouse model

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Objective: Non-alcoholic fatty liver disease (NAFLD) is an increasingly common disease, which can lead to hepatocellular carcinoma (HCC). It is associated with an increased portal pressure, which can alter the intestinal barrier, increase the translocation of bacterial products, and further worsen NAFLD. We hypothesized that this vicious circle can be broken by surgical porto-systemic vein shunting (PSVS), and previously demonstrated that PSVS can decrease the histological features of NAFLD in a high-fat diet (HFD) mouse model. We now test whether PSVS can also impact de-novo hepatocarcinogenesis.
Methods: C57BL/6 mice received HFD starting from 4 weeks of age. HCC was induced by intraperitoneal injection of DEN at 25mg/kg on week 2 and PSVS (n = 18) (or sham surgery (n = 18)) are created at 8 weeks. HCC burden was assessed by MRI and, finally, by macroscopic and histomorphology assessments. HCC features of aggressiveness, including solid growth pattern and fat component have been also evaluated.
Results: At 40 weeks of HFD feeding, tumors were identified in all the animals. Shunted HFD mice showed a reduced number of tumor nodules compared to sham (median nodules 8 vs 14, -42.9%; p = 0.0471) while associated to a greater average total tumor volume (709.3 vs 197 mm3, +258,6%; p = 0.0245). This correlated with an increased median tumor volume in shunted mice (16.30 vs 72.45 mm3, +344,5%; p = 0.0011). Notably, HCC histology of shunted mice was hallmarked by accentuated trend concerning HCC fatty change combined to a less pronounced solid growth pattern (p = 0.193).
Conclusion: PSVS leads to the presence of larger HCCs, potentially linked to the proportionally increased arterial supply of the liver. However, it demonstrates a protective effect on HCC carcinogenesis (< number of tumors). Collectively, this data suggests that portal pressure could represent a potential therapeutic target to attenuate liver steatosis and NAFLD-related HCC carcinogenesis.

Dynamic assessment of the impact of gut microbiota transfer in a mouse model of chronic intestinal dysbiosis

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Objective: There is growing evidence supporting that the gut microbiota is a major driver of human health and disease. While gut microbiota transfer (GMT) is commonly used as an approach to restore "eubiosis", there is a surprising lack of data on whether the transferred microbiota efficiently and durably repopulate the gut of the transplanted subject. Moreover, little is known on the effects of GMT on non-alcoholic fatty liver disease (NAFLD).
Methods: Chronic dysbiosis and NAFLD-like liver injury were induced by feeding C57Bl/6j mice for 16 weeks with a high-fat diet. For GMT, dysbiotic mice underwent preliminary gut cleansing, followed by oral gavage with a suspension of fresh fecal matter procured from a pool of lean mice (1 dose, or 10 doses). We next characterized microbiota composition and we measured the relative abundance of specific pathobionts in recipient mice, using high-throughput shotgun analysis in a dynamic manner, over time. All experiments took place in a specific germ-free environment.
Results: After 4 months on a high-fat diet, mice displayed fatty liver infiltration with moderate parenchymal inflammatory changes. Dysbiosis was evidenced by a reduced bacterial diversity, as well as a dramatically increased abundance of Firmicutes, and lower Verrucomicrobia and Actinobacteria. Gut microbiota transfer was associated with a transitory reduction in NAFLD-induced hepatocellular injury. While dysbiotic mice displayed a shift in their microbiota composition towards that of lean donors after GMT, this effect rapidly faded after one week, and mice recovered their initial, dysbiotic microbiota.
Conclusion: The current study indicates that, when used in mice with chronically established dysbiosis, GMT is merely associated with transitory changes in gut microbiota composition, as well as significant but moderate reduction in hepatocellular injury.

Intrapleural hyperthermic chemotherapy induces pro-immunogenic e-selectin expression in the vasculature of malignant pleural mesothelioma

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Objective: Malignant pleural mesothelioma (MPM) is a deadly disease with dismal prognosis. Prior studies combining surgery with intrapleural hyperthermic chemotherapy (IPHC) have shown improved survivals in selected patients with MPM. However, the mechanisms by which IPHC acts on MPM and its microenvironment remains unknown. Here we focus on tumor endothelial adhesion molecule expression patterns.
Methods: First, we determined the impact of IPHC on MPM tumor and vascular compartments in vitro using a novel bioincubater for hyperthermic cell culture. The cytotoxicity of normo (37 °C) / hyperthermic (42 °C for 60 minutes) cisplatin/carboplatin therapies were evaluated on four MPM (MSTO211H, H-Meso, AE17 and AB12) and one endothelial (EC-RF24) cell lines at a minimum of 24 hours using a presto-blue assay. Second, we treated endothelial cells with IPHC (60 min, 42 °C at optimized cytotoxic concentrations) and determined its impact on pro-immunogenic adhesion molecule (E-selectin, VE-cadherin, VCAM and Connexin-43) expression at 24 hours by Western blot.
Results: Tumor and endothelial cell viability decreased with increasing doses of both chemotherapeutics but was not affected by hyperthermia (IC50 with or without hyperthermia of each cell line at 24 hours reported in Figure 1A). Interestingly, endothelial cell line IC50 was much higher than that of MPM tumor cells for both chemotherapeutics (Figure 1A). Pro-immunogenic adhesion molecule E-Selectin was increased at 24 hours by IPHC with both chemotherapeutics while VE-Cadherin, VCAM and Connexin-43 were not affected (Figure 1B).
Conclusion: Hyperthermia adds no cytotoxicity to intrapleural chemotherapy. However, IPHC favors pro-immunogenic endothelial E-selectin expression. The latter could help induce patient immunity against their MPM and improve survival. Confirmation of these findings in vivo is mandatory.

Brief dietary protein dilution using carbohydrate rich drink protects from kidney ischemia and reperfusion injuries trough IGF-1

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Objective: Lifelong low-protein, high-carbohydrate diets extend lifespan in rodent. Consistently in human, the administration of oral carbohydrate drinks the day before surgery might improve clinical outcome. However, the fundamental questions of what represents a macronutritionally balanced diet, and how this impact surgical stress remain unanswered.
Methods: Here, we induced dietary protein dilution by giving mice ad libitum access to 50% sucrose water, without any food restriction. Mice were randomized into four regimens: regular diet (17,6 % protein, Ctrl), and a low protein diet (5.6% protein, LP), with or without high sucrose water (50% sucrose) for 7 days. At the end of the preconditioning, calorimetric data, fasting blood glucose, IGF1, glucose tolerance, and finally resistance to renal failure following a bilateral renal ischemia-reperfusion was evaluated.
Results: We demonstrate that access to carbohydrate drinks promotes dietary protein restriction despite a total caloric intake that was twice higher. This short-term self-restriction in daily protein, independent of caloric intake, improved insulin sensitivity, reduced serum triglyceride,

and enhanced mitochondrial respiration as well as energy expenditure. Importantly, a 7-day pre-conditioning protein dilution regimen promotes recovery following kidney ischemia and reperfusion (IRI), a model of surgical stress. This protection from kidney IRI inversely correlated with pre-operative protein intake, but not carbohydrate or fat. The benefit of a low protein, high-carbohydrate regimen was independent of the protein sensing pathway eIF2α/ATF4, NRF2 and hydrogen sulfide, but instead required Insulin-like growth factor 1 (IGF1) downregulation.
Conclusion: These results support further clinical studies of a low protein diet combined with carbohydrate drinks prior to surgery.

Advanced Training

How surgical training in Switzerland affects outcomes and new predictors for teaching

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Objective: Teaching in the operating room represents the cornerstone of surgical education. Residents need to perform a sufficient number of basic procedures in order to gain independence. However, it is still debated what impact surgical teaching has on outcomes. With this study, we provide recent data of a large national cohort and identify new factors that are associated with increased teaching.
Methods: We studied common procedures that are essential for surgical training: Laparoscopic Appendectomy (LA), Laparoscopic Cholecystectomy (LC), ostomy closure (OC), laparoscopic (LH) and Open Inguinal Hernia Repair (OH). The national database of the Swiss association for quality management in surgery was screened, and 72072 patients were identified from 2009 to 2019. Teaching was defined as a procedure mainly performed by a surgeon in training under supervision.
Results: A minority of basic surgical procedures were used for teaching (LA 28.1%, LC 22.3%, OC 21.5%, OH 31.8%, LH 6.3%), even in teaching hospitals of > 200 beds (LA 33.0%, LC 32.9%, OC 27%, OH 51.5%, LH 6.5%). During the study period, there was also generally a trend towards less teaching, exemplified by the two most frequent procedures: LA 35.6 to 26.7% (-25.0%, $p = <0.001$), LC 27.6 to 18.9% (-31.5%, $p = <0.001$). Operating time was significantly longer for procedures that were used for teaching with a more pronounced effect for inguinal hernia repairs: LA 63.4 vs 57.5min (+10.3%, $p = <0.001$), LC 84.0 vs 74.9min (+12.1%, $p = <0.001$), OC 88.6 vs 81.6min (+8.6%, $p = <0.001$), OH 81.5 vs 68.3min (+19.3%, $p = <0.001$), LH 97.9 vs 73.8min (+32.7%, $p = <0.001$). The overall complication rate for LA (2.6 vs 1.8%, $p = <0.001$) and LC (3.6 vs 2.8%, $p = <0.001$) were slightly higher in the no-teaching group and without a significant difference between the groups for OC, LH and OH. We identified the following parameters associated with increased teaching: A hospital size above 200 beds (OR = 2.48, $p = <0.001$), an operation during office hours (OR = 1.27, $p = <0.001$), the summer months (OR = 1.11, $p = <0.001$) and weekdays (OR = 1.10, $p = 0.003$).
Conclusion: The teaching of basic surgical procedures appears safe. Even if associated with longer operating times, it should be promoted as teaching is currently only performed in a minority of procedures (10-33%).

Nationwide study on stress perception among surgical residents

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Objective: Declining number of applicants and high attrition of residents are a dire reality. Surgeons in training are confronted to various stressors which interfere with their performance and may promote burnout. This study measures stress levels of Swiss surgical residents while considering age, gender, specialty, position, native language, and experience.
Methods: Swiss surgery residents taking the Surgical Basic Exam from 2016 to 2020 completed the Perceived Stress Scale 10 (PSS). The PSS measures how unpredictable, uncontrollable, and overloaded respondents evaluate their work life. Scores up to 13 are normal and scores around 20 are highly pathologic. High subscores of helplessness (PH) and lower subscores of self-efficay (PSE) indicate distress.
Results: 1694 questionnaires were evaluated (return rate 95.7%). Resident median (m) age was 29 years, 56.5% were male and 43.5% female. 72.7% of the residents were in their first 2 years of training, aiming for orthopedic (24%), general surgery (23.8%), urology (6%), or plastic surgery (5.6%). Residents reported a high PSS ($m = 15$), a high PH ($m = 9$), and an ordinary PSE ($m = 5$). Females reported worse PSS ($p < 0.001$), PH ($p < 0.001$), and PSE ($p = 0.036$) than males. Visceral and orthopedic surgeons had significantly better PSS, PH, and PSE.
In multivariable analysis, male sex ($p < 0.001$), aiming at orthopedic ($p = 0.017$) or visceral surgery ($p = 0.004$), and French as a mother tongue ($p = 0.037$) predicted lower stress levels, while graduating from a country not adjacent to Switzerland led to higher stress ($p = 0.047$). Similarly, male sex ($p < 0.001$), visceral surgery ($p = 0.032$), French mother tongue ($p = 0.018$), and more than 5 years in training independently predicted lower PH. Last, PSE was not influenced by gender, while residents in training for orthopedic ($p = 0.004$), visceral ($p = 0.007$) and urology ($p = 0.014$) specialities, as well as Italian native speakers ($p = 0.017$) reported less PSE.
Conclusion: Perceived stress levels are high in both genders in this large, prospective and representative cohort study of Swiss surgical residents. Females endured significantly worse stress and helplessness levels than males. These figures are worrisome as they may directly contribute to the declining attractivity of surgical residencies. Detailed and gender specific analysis of stressors during residency are urgently needed to improve residency programs.

Value Based Health Care

Outcome measurement in trauma surgery with a fracture database and clinical and patient-reported outcome measures (PROMs)

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Objective: Patient-Reported Outcome Measures (PROMs) gain growing attention. The Food and Drug Administration suggested in 2009 to have PROMs for every new treatment and technology. The use of PROMs was further promoted by the Patient Protection and Affordable Care Act of 2010 in the USA. Recommendations from other national and international organizations include the OECD's Project of Patient-Reported Indicator Surveys (PaRIS) and the International Consortium for Health Outcomes Measurement (ICHOM). Our development and initiation of a Fracture Database started early in 2018. We orientated our database on the role model of the Swedish Fracture Registry.
Methods: REDCap (Research Electronic Data Capture) is a web interface for a SQL (Structured Query Language)-Database. We used it to program the Fracture Registry. We collect data about demographics, diagnosis, treatment, adverse events, clinical outcomes, and PROMs. The PROMS are recorded with the Software 'Heartbeat ONE' vs. 6.15.4. Inclusion criteria are all patients with fractures of the upper and lower extremity, including the pelvis and multiple injuries, treated surgically. Excluded are all patients with fractures of the hand as monotrauma and non-surgical treatment. We established questionnaire sets for each anatomical region. Every hospitalized patient is screened for inclusion criteria to get the baseline PROMs. Follow-up PROMs are collected at 3-months and 12-months in our outpatient clinic.
Results: In five months of collecting PROMs, we have evaluated 599 patients, 521 fulfilling the inclusion criteria. 329 (63%) questionnaire

sets were completed. The mean time for answering the questions was 11-20 minutes. The input rate of 63% for PROMs accounts for the start of the process, with 22 (4%) patients being dismissed before answering the questionnaires. 93 (18%) patients denied participation. 52 (10%) patients were not able to participate (dementia, delirium). Other causes for missing data were language barriers (n = 28; 5%), medical reasons like polytraumatized patients (n = 4; 0.8%), and deceased patients (n = 15; 2.9%).

Conclusion: Most Orthopaedic Trauma centers publish data about PROMs from surgically treated patients. Starting in the first quarter of 2021, we will include non-surgically treated patients. We have optimized the process of including patients. Our aim is a response rate of more than 80% within this year to get representing data.

Varia

Surgical skill assessment using machine learning algorithms

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Objective: Surgical skill is correlated with clinical outcomes. Therefore, the assessment of surgical skill is of major importance to improve clinical outcomes and increase patient safety. However, surgical skill assessment often lacks objectivity and reproducibility. Furthermore, it is time-consuming and expensive. Therefore, we developed an automated surgical skill assessment using machine learning algorithms.

Methods: Surgical skills were assessed in videos of laparoscopic cholecystectomy using a three-step machine learning algorithm. First, a three-dimensional convolutional neural network was trained to localize and classify the instruments within the videos. Second, movement patterns of the instruments were recorded over time and extracted. Third, the movement patterns were correlated with human surgical skill ratings using a linear regression model to predict surgical skill ratings automatically. Machine ratings were compared against human ratings of four board certified surgeons using a score ranging from 1 (poor skills) to 5 (excellent skills).

Results: Human raters and machine learning algorithms assessed surgical skills in 242 videos. Inter-rater reliability for human raters was excellent (79%, 95%CI 72-85%). Instrument detection showed an average precision of 78% and average recall of 82%. Machine learning algorithms showed an 87% accuracy in predicting good or poor surgical skills, when compared to human raters.

Conclusion: Machine learning algorithms can be trained to distinguish good and poor surgical skills with high accuracy.

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The use of single incision laparoscopic surgery techniques and natural orifice transluminal endoscopic surgery – a nationwide survey

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Objective: Since the first report of transgastric peritoneoscopic surgery in 2004, minimal invasive surgery (MIS) including conventional laparoscopy, natural orifice transluminal endoscopic surgery (NOTES), single incision laparoscopic surgery (SILS), and robotic surgery have gained traction in general and visceral surgery. While laparoscopic surgery is now the gold standard in many institutions, other MIS approaches lag behind in spite of the enthusiasm of few promoters.

The present study investigates the current role of NOTES and SILS in Switzerland.

Methods: All Swiss surgical departments where queried. Heads of department were asked to complete a detailed questionnaire regarding the use of NOTES and SILS techniques, reminders were sent twice.

Results: Of 93 departments queried, 63 (68%) answered the survey and most were public hospitals (92%). One third of general surgery departments and 46% of visceral surgery departments had the highest accreditation level A and V1, respectively.

While up to 27% of the responding hospitals had performed NOTES in the past, only about 9% still use the technique today. Since January 2019, only two departments performed NOTES cholecystectomy, one department NOTES colectomy and three departments NOTES total mesorectal excision.

The main reasons for not performing NOTES anymore were lack of perceived benefits, higher costs, increased morbidity in routine procedures, no patient demand, and the lack of surgical expertise.

A similar picture was found regarding the use of SILS, with 37% of hospitals having past experience with SILS and only 13% still performing SILS procedures. Yet, significantly more institutions performed a broader range of SILS procedures today:

SILS appendectomy (n = 2), SILS cholecystectomy (n = 4), SILS thyroidectomy (n = 1), SILS small bowel resection (n = 2), SILS colonic resection (n = 5), and SILS rectal resection (n = 2). The main reasons for not performing routinely SILS were similar to the rationale against NOTES.

Conclusion: Due to technical limitations and lack of perceptible benefits, NOTES and SILS are less frequently performed nowadays than they were in the past. Only a minority of departments are still performing NOTES and SILS, including cholecystectomies, appendectomies, thyroidectomies, and bowel resections. Whether the rise in use of robotic techniques correlates with the decrease of NOTES and SILS needs further investigation.

Feasibility of a prehabilitation program before major abdominal surgery

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Objective: Prehabilitation programs claim to improve exercise capacity and postoperative outcomes. The study aim was to assess the feasibility of a prehabilitation program and its effects on fitness and clinical outcomes after major abdominal surgery.

Methods: In this prospective pilot study, patients were assigned to high-intensity physical exercise training with 3 training sessions per week for 3 weeks preoperatively. Feasibility of this intervention was assessed based on recruitment and adherence to the training program. Impact on fitness (VO2 AT) was evaluated and correlated with complications and length of stay (LOS).

Results: Of 980 eligible patients, 87 patients (8.9%) were approached for inclusion. Main obstacles to not approach patients were insufficient time (< 3 weeks) prior to scheduled surgery (n = 276, 28.2%) or screening failure (n = 312, 31.8%). Out of these 87 patients, 24 (28%) declined to participate, 43 (49%) met exclusion criteria and 20 (23%) were included. Six patients (30%) could not complete the prehabilitation program due to contra-indication for exercise training evidenced during the test (n = 3), lack of motivation (n = 2) and modification of the planned operating date (n = 1). VO2 AT increased from 9.8 to 11.5 ml/min/kg (p = 0.050). There were no correlations between the change in VO2 AT and postoperative complications (r = -0.133, p = 0.649) and LOS (r = -0.94, p = 0.750).

Conclusion: Prehabilitation programs are difficult to implement and many patients are either not eligible or not motivated. Future efforts should concentrate on those patients who are most likely to benefit from these time- and cost-intensive interventions.

Real-time clipper tip visibility detection using computer vision

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Objective: Laparoscopic cholecystectomy is one of the most common laparoscopic procedures. The critical phase of this intervention consists in dissecting the hepatocystic triangle and clipping the cystic artery and duct. Poor visibility of the clipper tips can result in unintentional clipping of neighboring tissues ("past-pointing") or improper enclosing of the artery or duct, leading to hemorrhage or bile leaks. To improve patient safety during this clipping phase, we propose real-time intraoperative feedback to alert a surgeon when departing from safe behavior, i.e., losing visibility of the clipper tip. This is achieved using a deep learning model which classifies the clipper tip visibility in each frame.

Methods: We tailored a dataset for our application by selecting frames containing a clipper that were selected from 300 laparoscopic cholecystectomy videos. These 122k frames were annotated with binary labels: clipper tip visible/invisible. A frame was labelled as tip visible when the tips of both clipper jaws were visible. Frames in which the clipper tip was occluded (e.g. by tissue) or frames with poor image quality (e.g., bad contrast, blurriness/smoke) were labelled as tip invisible. Frames from 29 videos were set aside for a test set; the remaining frames were used for training/validation (80%, 20% resp.).

Using a 5-fold cross-validation scheme, convolutional neural networks (Resnet50 architecture) were trained to classify the clipper tip visibility in each frame. Finally, 5 neural networks trained in the cross-validation were ensembled into a single model by averaging their predictions.

Results: On the test set, the ensembled model achieved an AUROC of 0.906 and a specificity of 64.5% at 95% sensitivity. Looking at per video performance, the median specificity across videos raised to 76.6% (at 95% sensitivity). That is, the model would correctly detect 95% of the clipper tip not visible cases; in the majority of the interventions, 7 out of 10 warnings would be justified.

Conclusion: We propose a novel safety feedback which warns on poor visibility of the clipper while clipping the cystic duct or artery. While being accurate, our technical solution runs in real-time, a requirement for intraoperative use. We believe this feedback can raise surgeons' attentiveness when departing from safe visibility during this critical phase of laparoscopic cholecystectomy.