Physical Support System for Surgeons At The Operating Table - Need, Development, Co-Creation and Solution

ID: 208

Martin U. Schuhmann*1, Justus Marquetand2, Volker Steger3, Karolin Thiel4, Silvio Nadalin4, Benjamin Steinhiuber5, Felix Neunhoeffer6

1Klinik für Neurochirurgie, Universitätsklinikum Tübingen, Tübingen, Deutschland, 2Klinik für Epileptologie, Hertie-Institute for Clinical Brain Research, Universitätsklinikum Tübingen, 3Klinik für Thorax-, Herz und Gefäßchirurgie, Universitätsklinikum Tübingen, 4Klinik für Allgemeine, Viszeral und Transplantationschirurgie, Universitätsklinikum Tübingen, 5Institut für Arbeitsmedizin, Sozialmedizin und Versorgungsforschung, Universitätsklinikum Tübingen, 6Klinik für Kinder- und Jugendmedizin, Universitätsklinikum Tübingen

Background:
Surgical innovation has centered on instrumentation, visualization, robotics and intraoperative diagnostics and could successfully improve patients outcome. Surgeons themselves have not been in the focus of innovation, although they are exposed to a variety of complex and long procedures with static and/or awkward body positions, resulting in considerable physical strain and stress on their musculoskeletal system. The most experienced and highly performing surgeons are furthermore in the age group of 50+ years. Increasing intraoperative muscular fatigue affects surgical precision, endurance and mental focus. As a result, musculoskeletal disorders and pain are part of daily surgical practice and can trigger disease related off-work periods. Consequently, there is an urgent need for surgical support systems to reduce the physical strain on surgeons during surgery and to maintain their skills and health.

Materials and methods:
Based on the described demand, a working group of surgeons, physicians, engineers, and nurses formed and analyzed the needs of surgeons during operation by pre- and postoperative interviews, observing and photographic documentation of body postures during surgery. This was followed by the vision, creation, and construction of a first prototype of a surgical support system with mainly anterior chest support. Utilizing this prototype, a pilot study was conducted to investigate the potential of the physical support system on back and leg muscles relief. Therefore, electromyographic and muscle perfusion measurements with and without the support prototype were recorded during typical bent-over surgical posture. A start-up company was founded, a business plan developed, support from business angels sought and investors searched.

Results:
The initial prototype study revealed that the use of the prototype significantly decreased muscle activity and fatigue compared to control. Muscle blood flow and oxygenation were relatively close to baseline with physical support, but increased without {1}. In continuation of those encouraging results, several steps of engineering refinement followed, leading to a change from anterior support to a backpack type posterior holding system, incorporation of an electronic steering system, and sensor-based intuitive movement features. Each development step was or is accompanied by close feedback from the experience of surgical users directly from the operating tables of various disciplines. This co-creation principle of surgeons, physicians, neurologist, nurses, engineers, entrepreneurs, and economists encouraged several groups of business investors to open the avenue for the final creation and production of a surgical support system available to surgeons in 2022.

(1) Marquetand J et al., Ergonomics for surgeons – prototype of an external surgeon support system reduces muscular activity and fatigue, Journal of Electromyography and Kinesiology, Volume 60, 2021, 102586, ISSN 1050-6411
Conclusion:
The need to improve ergonomics of surgeons to support and maintain their expertise and abilities resulted in an interdisciplinary effort of experts from surgery, medicine, neurology, engineers and the business world to realize the vision of minimizing musculoskeletal fatigue and pain, thus elevating the quality of surgery for the surgeons themselves.
LASER-therapy as a novel option for pediatric pilonidal disease

ID: 456

Mohamad Alrefai¹, Matthias Nissen¹, Anna Romanova¹, Jochen Hubertus¹
¹Ruhr-Universität Bochum, Klinik für Kinderchirurgie, Witten, Deutschland

Background: Pilonidal disease is an acquired condition related to hair-induced mechanical forces on the skin surface of the intergluteal cleft with subsequent abscess formation with or without concomitant draining sinus (pit). The current mainstay is surgical management. Recently, LASER-therapy has been propagated as a promising treatment option at non-inflammatory state. Remarkably, no data exists regarding LASER-therapy for pilonidal disease in children.

Materials and methods: Herein, we describe our preliminary experience with LASER-therapy on children with pilonidal disease, aged below 14 years, that were treated at our tertiary pediatric surgical hospital between 2019 and 2021. The data was retrospectively analyzed in relation to perioperative characteristics and the clinical outcome on follow-up assessment.

Results: Nine consecutive patients underwent LASER-therapy for pilonidal disease with a female preponderance (n= 7; 78%). At timepoint of treatment, the median (IQR) age was 13 (2) years and the body mass index was 21.5 (3) kg/m². Median procedure duration was 15 (6) minutes while follow-up period was 3 (4) months with a recurrence rate of n= 1 (11%). Regarding postsurgical scar assessment, the overall Vancouver Scar Scale Score (ranging from 0-13; the higher the worse) was 1 (2) while the Patient and Observer Scar Assessment Scale Scores (ranging from 6-60, the higher the worse) were 15 (10) and 11 (8), respectively.

Conclusion: LASER-therapy constitutes a novel approach for management of pediatric pilonidal disease. Our preliminary results on treatment outcome are promising. More research is needed to determine the value of this new technique.
Use of barbed resorbable sutures for thoracoscopic or open congenital diaphragmatic hernia repair

ID: 673

Nadine Muensterer¹, Christiane Zeller¹, Anne-Sophie Holler¹, Elena Weigl¹, Oliver Muensterer*¹
¹Kinderchirurgische Klinik, Dr. von Haunersches Kinderspital, LMU Klinikum, München, Deutschland

Background:
Diaphragmatic hernia repair in small newborns can be challenging, particularly when a larger defect is present with resulting tension during repair. Barbed sutures prevent the suture from slipping back after approximation of the tissues. Although barbed sutures have been introduced for at least 15 years, they have not been widely employed for congenital diaphragmatic hernia repair. We report our initial experience with barbed sutures for diaphragmatic hernia repair.

Materials and methods:
We report congenital diaphragmatic hernia (CDH) repair using a Polyglyconat barbed suture in three newborns. Demographics, operative parameters, complications, and outcomes were prospectively recorded in a registry. Consent was obtained by all families.

Results:
Specific demographic and outcome data is presented in the table below. Operative times were between 46 and 89 minutes. The barbed suture facilitated easy and quick closure of the defects and obviated the need for intracorporeal knot-tying. The first two patients survived long-term without signs of recurrence. Diaphragmatic closure of the defect was easily accomplished via an open approach in patient 3. However, the patient died of complications and systemic-pulmonary shunt thrombosis at 18 days of age.

Conclusion:
Barbed sutures simplify congenital diaphragmatic hernia repair regardless of whether a minimal-invasive or open approach is performed. Because the tightened suture does not slip back and do not require knotting, they are particularly useful in patients with substantial co-morbidities in which short operative times are essential.

Table:
Characteristics of the included patients

<table>
<thead>
<tr>
<th>Patient</th>
<th>1</th>
<th>2</th>
<th>3</th>
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<tbody>
<tr>
<td>Sext</td>
<td>M</td>
<td>W</td>
<td>M</td>
</tr>
<tr>
<td>Gestational age at birth (wks)</td>
<td>36</td>
<td>33</td>
<td>38</td>
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<tr>
<td>Birth weight (g)</td>
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<td>1950</td>
<td>2830</td>
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<td>Co-morbidities</td>
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<td>bilateral VUR, pulmonary hypoplasia,</td>
<td>Pulmonary atresia, s/p systemic-pulmonary shunt,</td>
</tr>
<tr>
<td></td>
<td>pulmonary hypertension</td>
<td>pulmonary hypoplasia, pulmonary hypertension</td>
<td></td>
</tr>
<tr>
<td>------------------------------------------</td>
<td>-------------------------</td>
<td>---------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>Age at operation (d)</td>
<td>14</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Weight at operation (g)</td>
<td>2480</td>
<td>1910</td>
<td></td>
</tr>
<tr>
<td>Weight at operation (g)</td>
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<td>2910</td>
<td></td>
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<tr>
<td>Mode of operation</td>
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<td></td>
</tr>
<tr>
<td>Mode of operation</td>
<td></td>
<td>open, abdominal</td>
<td></td>
</tr>
<tr>
<td>Operative time (min)</td>
<td>64</td>
<td>89</td>
<td></td>
</tr>
<tr>
<td>Operative time (min)</td>
<td></td>
<td>46</td>
<td></td>
</tr>
<tr>
<td>Localization of diaphragmatic defect</td>
<td>Right posterior</td>
<td>Left posterior</td>
<td></td>
</tr>
<tr>
<td>Localization of diaphragmatic defect</td>
<td></td>
<td>Right posterior</td>
<td></td>
</tr>
<tr>
<td>Liver</td>
<td>up</td>
<td>up</td>
<td></td>
</tr>
<tr>
<td>Liver</td>
<td></td>
<td>up</td>
<td></td>
</tr>
<tr>
<td>Patch</td>
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<td></td>
</tr>
<tr>
<td>Patch</td>
<td></td>
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</tr>
<tr>
<td>Patch</td>
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<tr>
<td>Postoperative length of stay (d)</td>
<td>6</td>
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<td>Postoperative length of stay (d)</td>
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<td>18</td>
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<tr>
<td>Follow-up (months)</td>
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<td>6</td>
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<tr>
<td>Follow-up (months)</td>
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<tr>
<td>Outcome</td>
<td>No recurrence, doing well</td>
<td>No recurrence, doing well</td>
<td>Died at age 18d because of pulmonary hypoplasia, clottet systemic-pulmonary shunt</td>
</tr>
</tbody>
</table>
Immersion Anatomy Atlas: Learning Factual Medical Knowledge in a Virtual Reality Environment

ID: 365

Verena Uslar¹, Kilian Gloy¹, Maximilian Kaluschke², Gabriel Zachmann², Dirk Weyhe*¹
¹Carl von Ossietzky Universität Oldenburg, Universitätsklinik für Viszeralchirurgie, Oldenburg, Deutschland, ²Universität Bremen, AG Computergrafik, Bremen, Deutschland

Background:
In order to improve learning efficiency and memory retention in medical teaching, furthering active learning seems to be an effective alternative to classical teaching. One option to make active exploration of the subject matter possible is the use of virtual reality (VR) technology.

Materials and methods:
The authors developed an immersive anatomy atlas which allows users to explore human anatomical structures interactively through virtual dissection (Figure 1). Thirty-two senior-class students from two German high schools with no prior formal medical training were separated into two groups and tasked with answering an anatomical questionnaire. One group used traditional anatomical textbooks (Figure 2a) and the other used the immersive virtual reality atlas (Figure 2b). The time needed to answer the questions was measured. Several weeks later, the participants answered a similar questionnaire with different anatomical questions in order to test memory retention by analyzing the percentage of correct answers at both time points and for both groups.

Results:
There was a significant difference between the response times in the OB and the VR learning conditions, as shown by the Wilcoxon rank sum test (p < 0.001). It took the participants significantly longer to answer the questions in the OB condition (median = 119.5 seconds) than in the VR condition (median = 78.3 seconds). This difference represents a large effect.

There was a significant main effect of test time (Test 1 vs. Test 2), a significant main effect of learning method (OB vs. VR), and a significant difference between schools. OB, open book; VR, virtual reality. Significant differences between groups (P < 0.01). In general, participants using the VR atlas achieved better results (mean ± SD of correct answers = 73 ± 22%) than those working with books (mean ± SD of correct answers = 60 ± 25%). The associated effect size represents a large effect.

Conclusion:
Based on the results of this study, VR learning seems to be more efficient and to have better long-term effects for the study of anatomy. The reason for that could lie in the VR environment's high immersion, and the possibility to freely and interactively explore a realistic representation of human anatomy. In our opinion, immersive VR technology thus offers many possibilities for medical teaching and training, especially as a support for cadaver dissection courses.

Figure 1: Immersive Anatomy Atlas. A, Overview of the 3D environment that comprises the virtual operating room. The camera is positioned in one of the rooms upper corners; B, A cross-section of the anatomical model, generated with the use of virtual tools. The pointing baton (1) makes a spherical area around its tip transparent. The cross-sectional tool (2) makes everything on the front side of the imaginary plane which passes through the tool transparent. The combination of these tools enables the user to inspect any part of the model.

Figure 2: Impressions of the experimental setup for Test 1. A, The open book condition; A student is using the textbooks supplied to them to answer the questionnaire. A timer can be seen at the lower edge of the panel, measuring response times. B, The virtual reality condition; A student wearing the head-mounted display (HMD) is using the immersive anatomy atlas to answer the questionnaire. A space has been cleared around them to allow for free movement in the virtual reality environment. At the left edge of the panel, the monitor shows what the student is currently seeing in their display.
Hyperspectral Quantification of Gastric Venous Congestion after total Pancreatectomy (A video contribution)

ID: 410

Tristan Wagner*, Pawel Bieniek1, Shadi Katou1, Philip Wahl2, Felix Becker1, Philipp Houben1, Morgül Haluk1, Andreas Pascher1, Sonia Radünz1, Benjamin Struecker1
1Department of General, Visceral and Transplant Surgery, University Hospital Münster, Germany, Münster, Deutschland, 2Diaspective Vision

Background:
Gastric venous congestion (GVC) is a common and potentially life-threatening complication after total pancreatectomy. In case of splenectomy and/or coronary vein resection the incidence of ischemic gastric complications even rises due to GVC with consecutive arterial stasis, tissue hypoxia and gastric necrosis. If GVC is diagnosed, it is associated with a high mortality rate (up to 24,1%). So far, there is no intraoperative, non-invasive method to objectively describe and reliably predict postoperative GVC. Aim of this case report was to evaluate GVC using intraoperatively hyperspectral imaging (HSI).

Materials and methods:
Hyperspectral analysis was performed during total pancreatectomy with splenectomy in a patient with Von Hippel–Lindau disease (VHL). Oxygen saturation (StO2), near infrared perfusion index (NIR), organ hemoglobin index (OHI) and tissue water index (TWI) at the lesser and greater gastric curvature and gastric parenchyma (corpus, fundus and pylorus) were measured. Five circular regions of interest (ROI) of the size of 10 mm were set at the smaller and larger curvature, three ROI’s of the size of 20 mm were placed at the antrum, corpus and fundus. HSI analysis started initially to distinguish a baseline of gastric perfusion before ligation of the draining veins. HSI analysis was repeated 10 minutes after ligation of the right gastric vein, ligation of the right gastroepiploic vein, ligation of the splenic vein, the left gastric epiploic veins and the short gastric veins. Finally, HSI analysis was performed before and after the gastric anastomosis. ROI’s were calculated and analyzed by TIVITA Software.

Results:
StO2, NIR, THI and TWI of the forty years old female patient were observed during surgery (time of surgery, 416 min). StO2 (86,3), NIR (71,0), THI (29,7) and TWI (52,3) after the initial preparation of the situus were used as the baseline values of the gastric perfusion. After Ligation of the right gastric vein and right gastroepiploic vein StO2 (91,6), NIR (74,1), THI (39,4) and TWI (55,6) increased. After Ligation of splenic vein, small gastric veins and left gastroepiploic vein StO2 (76,2) and NIR (71,3) decreased, THI (49,4) and TWI (55,6) constantly raised. StO2 (69,6) and NIR (71) further dropped after one hour of ligation of the venous gastric drainage and THI (60,1) and TWI (50,8) on the other hand increased. At the end of surgery, 73 min later on, after gastric anastomosis the superficially StO2 (71,8) and TWI (58,7) stabilized, but NIR (63) in 6mm depth on the other hand decreased. THI (69,3) increased. Compared to the initial perfusion, without the impact of vosopressiv drugs and correction of hypovolemia, we could see a significant decrease of StO2 (p 0,069) and NIR (p 0,003) while THI (p 0,01) and TWI (p 0,04) increased.

Conclusion:
HSI is capable to detect gastric oxygen saturation. The significant increase of THI most likely due to venous ligation could explain the decrease of StO2 and NIR (Figure234). Besides prolonged gastric emptying no postoperative complication was observed. HSI could be used to objectively measure intraoperative gastric venous congestion to indicate simultaneous gastric resection when needed and therefore help to prevent severe postoperative complications after pancreatectomies.
Registration accuracy using the main portal-vein branch as vascular landmark acquired by intraoperative ultrasound for 3D-navigated liver resection

ID: 914

Nonkoh Joshua Sheriff*1, Michael Thomas2, Alexander Bunck3, Rabi Raj Datta1, Christiane J. Bruns2, Dirk Ludger Stippel2, Matthias Peterhans4, Roger Wahba1

1Klinik und Poliklinik für Allgemein-, Viszeral-, Tumor- und Transplantationschirurgie, Uniklinik Köln, Köln, Deutschland, 2Klinik und Poliklinik für Allgemein-, Viszeral-, Tumor- und Transplantationschirurgie, Uniklinik Köln, 3 Institut für Diagnostische und Interventionelle Radiologie, Uniklinik Köln 4Cascination AG, Bern, Schweiz

Background:
The accuracy of image registration for 3D-navigated liver resection is crucial. Registration with intraoperative ultrasound (IOUS) using the right or left main portal-vein branch (RPV/LPV) as landmark has the potential to optimize the accuracy and reduce errors compared to traditional liver surface landmark acquisition. Aim of this study was to analyze the IOUS registration process regarding the distance to the portal vein branches and compare the registration process using a commercial vs. an in-house 3D liver model.

Results:
109 measurements were performed. Accuracy defined by the mean registration error ± standard error using the left portal vein branch was 6.2 ± 0.85 mm, the right branch 10.41 ± 0.99 mm, resulting in a mean difference of 4.21 ± 0.92 mm (p < 0.001; 95%-CI = 2.39 to 6.03 mm). There was a statistically significant but weak positive correlation (p < 0.001; R²= 0.089) between distance to the acquired portal vein branch landmark and the resulting registration error, suggesting a higher accuracy in a distance up to 4 cm to the PV. Registration error comparing a commercial 3D-liver model vs. in-house 3D-liver model was statistically not different (8.76 ± 0.9 mm vs 7.85 ± 0.9 mm, p=0.272).

Conclusion:
IOUS registration algorithm tends to have a higher accuracy in a distance up to 4 cm to the region of interest. Accuracy was higher when using the left main portal-vein branch as landmark. Registration using an in-house 3D liver model was equivalent to the registration using a commercial 3D liver model.

Disclosure of interest: None declared
Registration of CT images with augmented reality (AR) in open liver and pancreas surgery
ID: 963

Daniela Salzmann*, Simon Furrer2, Marc-Angelo Bisotti2, Sirko Pelzl2, Dirk Weyhe1
1PIUS-Hospital Oldenburg, Oldenburg, Deutschland, 2apoQlar GmbH, Hamburg, Deutschland

Background:
Augmented reality based navigated surgery is increasingly being tested and integrated in surgical practice. The basis for navigated surgery is a fully automatic registration in real time. Registration is the process by which corresponding data points in the virtual and real images are merged together into one coordinate system. With a new developed augmented reality application tool an automatic registration in real time is possible and patient specific 3D models generated from preoperative images can superimposed on the real view of the surgical field to provide surgeons with improved imaging of anatomical structures through interoperative procedure. The aim of the study is the intraoperative testing of the automatic placement of the new application. The secondary endpoint refers to the evaluation of the usability of this new application.

Materials and methods:
All patients with indication for open liver or pancreas surgery are included. During surgery, the use of the AR application for automatic placement is performed by the 1st surgeon or 1st assistant to project the digital image data onto the surgical site. The view of the Mixed reality glasses will be streamed onto an OR-Display and will be recorded. In addition, a written survey of the participating surgeons who tested and applied the automatic placement during the operation will be conducted postoperatively. The questions are adapted from literature and focused on the following topics: automatic registration, accuracy (fiducial / target registration error), stability of registration, processing time of automatic registration, usability and desired improvements to the application. Patient related data such as sociodemographic (age, gender) and health-related data (CT or MRI images including their findings, diagnosis, surgical indication, R-classification as well as surgery-related data such as surgery duration, anesthesia time, surgical method, Clavien-Dindo, transfusion as well as pathological findings like metastases/tumor dimensions are added for documentation. In advance, a pre-test of the placement and the questionnaire will be conducted with two surgeons to test the technical feasibility of the placement as well as the developed questionnaire. Data will be analyzed using descriptive statistics. Since these are initial trials with few study participants, no statistical analysis is performed as has been common in the literature. Observations and open questions are categorized, summarized and compared by frequency analysis.

Results:
The new release of the application of the automatic placement will be available for testing beginning in October 2021. The data collection period will end at the end of the project in March 2022. The patients will be described using sociodemographic and health-related data as described. In addition, results regarding accuracy, stability of placement, duration of automatic placement will be reported. These aspects are expected to differ with respect to the liver due to greater respiratory displacement as well as the pancreas. In addition, the evaluations regarding the usability of the application on the part of the surgeons are presented.

Conclusion:
A first evaluation of the new automatic placement tool will be carried out in visceral surgical practice. Automatic registration is under development, therefore perioperative aspects are collected to describe the patient collective, but not evaluated regarding the benefit of the application. The exact projection onto the patient situs is a first step towards navigated surgery. If the trial proves to be successful, further
Clinical trials on the feasibility of navigated surgery, the benefit on surgical time, surgical outcomes and patient’s recovery of the new application will be planned.
Revolutionizing surgical side infection (SSI) surveillance with personalized digital patient wound follow-up
ID: 457

Nora Mayer*1, Shehani Alwis1, Melissa Rochon1, Nisar Asadi1
1Royal Brompton & Harefield Hospital, Part of Guy’s and St. Thomas NHS Foundation Trust, Harefield, United Kingdom

Background:
Surgical side infection (SSI) is the most costly healthcare associated infection and occurs within 30 days of surgery, in more than 70% post discharge. Short hospital stays and remaining chest drains/indwelling devices specifically expose thoracic surgical patients to SSI. Feasibility studies indicate positive patient experiences using mobile technology to monitor their wounds. The aim of our study is to introduce a personalized digital solution for SSI surveillance.

Materials and methods:
Between November 2020 and July 2021, 158 patients were included in the PaD (Photo at Discharge) platform (ISLA Health LTD). Wound photos were taken at discharge and patients were asked to upload a wound photo from home 7 days post discharge (Figure 1A+B). Patient response, satisfaction and avoided travel distance were used as early outcome measures.

Results:
Patient response was 42% (67 submissions) and 44 patients (66%) participated in our satisfaction evaluation. 3 patients (6.8% PaD user, 1.9% of whole cohort) were diagnosed with SSI and treated conservatively. 1985km travel distance were avoided (Figure 1C). None of the patients expressed concerns about sharing anonymised visual information online and 93% found it easier to upload a wound photo to the platform (Figure 1D) than describing their wound over the phone. 77.2% of the patients found the platform easy to use and for 88% the photo upload at a scheduled time 7 days postoperative was convenient.

Conclusion:
The PaD platform was successfully implemented in our thoracic surgical department with good response and high patient satisfaction rating.

5G enabling new applications for telemedicine - eHealth usecase "Remote Ultrasound"
Michael Kranzfelder1, Daniel Ostler1, Mohamed Gharba2, Helmut Friess1, Dirk Wilhelm1, Thomas Vogel1

1Klinikum rechts der Isar der Technischen Universität München, München, Deutschland, 2Huawei Munich Research Center, München, Deutschland

Background:
Emergency care prior to hospital diagnostic and treatment greatly benefits from the support of medical experts. Especially in rural areas with a shortage of medical staff and long distances to hospitals, fast and reliable emergency diagnostics, e.g. mobile ultrasound, significantly improves patient care. This virtual support by a medical expert can be achieved through telemedicine applications.

Materials and methods:
Telemedicine applications require reliable, fast and secure wireless data transmission. 5th generation mobile communications (5G) enables an up to 100x higher data rate (< 10,000 Mbps), up to 200x higher data capacity, and low latency (ping < 1 ms) compared to 4G/LTE and meets the requirements for track-and-trace and telemedicine applications. In this preclinical study, 5G-based data transmission of ultrasound, video and audio sources between an ambulance car and a hospital is evaluated. The 5G network uses a carrier frequency (C-band) of 3.41 GHz and bandwidth of 40 MHz. Both the base transceiver station (BTS) and the unified user equipment (UE) modem consist of 8 antennas. Ultrasonography was performed using Clarius C3 HD (2-6 MHz) multipurpose scanner (Clarius Mobile Health Corp., Vancouver, Canada). An IP-based pan-tilt-zoom (PTZ) camera was used for video and audio transmission (Hikvision DS-2DE2A404IW-DE3/W, Hangzhou, China).

Results:
The ultrasound system was successfully connected to the 5G modem/processing system installed in the ambulance car. The remote hospital PC was integrated with the base transceiver station. The data throughput over the 5G network showed a peak of 6 Mbps. The Transmission Control Protocol (TCP) showed a peak throughput of 650 Kbps and was transmitted with interruptions. The User Datagram Protocol (UDP) transmitted data representing the image/data stream from the ultrasound system to the remote PC without any interruptions.

Conclusion:
Preliminary tests of 5G-based data transmission were successfully conducted in our study and data throughput requirements for 5G e-health use cases were achieved. Ultrasound data was streamed to the remote PC over the 5G network. The log files were stored for further analysis.
Modern Aspects and Trends in Interdisciplinary Pain Management with Special Reference to the Carious Surgical Disciplines - Clinical Research Results of an Interdisciplinary Working Group at a Tertiary Center.

ID: 702

Michael Brinkers*, Giselher Pfau†, Frank Meyer‡

*Uniklinik Magdeburg, Schmerzambulanz, Magdeburg, Deutschland, †Uniklinik Magdeburg, Klinik für Allgemein-, Viszeral-, Gefäß- und Transplantationschirurgie, Magdeburg, Deutschland

Background:
The Options of pain therapy are manifold, ranging from infiltrations and blockades to stimulation, surgical procedures as well as physical and psychosocial measures. The guarantee and optimization of a low-pain to pain-free perioperative care management and reliable or sustainable efficacy and course are considered high demands in this context. This is especially true with regard to the invasiveness of surgical interventions, partially implemented multimodality as well as age, secondary disease and risk profile and, last but not least, the medication spectrum of patients.

Objective:
To summarize the results of an interdisciplinary clinical work and research group of the pain outpatient clinic and general/visceral surgery at a tertiary institution (university hospital) in a representative overview to reflect on upcoming research topics and current trends in the field.

Materials and methods:
This is a synopsis of written publications as well as lectures on the topic given by the two disciplines in recent years.

Results:
- The creation and implementation of an institutional pain management SOP ("standard operating procedure") represents a worthwhile and promising endeavor.
- For the ubiquitously possible application of the SOP, it is provided in the form of a pocket-sized manual for the medical staff.
- For quality assurance, the consults for pain patients are supervised by the senior physicians of the outpatient pain division.
- Visceral surgery poses an increased risk for the occurrence of back pain in later years.
- Own studies provide also reliable data showing effective pain therapy with Novaminsulfon / NSAIDs and Dipidolor up to a postoperative duration of 8 days; especially for cancer patients, sustained-release opioids plus psychotropic drugs should be considered thereafter.
- Medications are then selected based on the patient’s quality of pain, which are complained about.
- In clinical practice, the level of pain is not a basis for assessing the medication required; pain level of the individual patient is used solely to assess the course of therapy.
- The consults are not solely for the purpose of administering opioids to every patient requested; the aim is rather the dissemination of the SOP, its internalization by the ward staff and, based on this, the implementation of a therapy adapted to the individual case - therefore, it seems necessary to increase the number of consults in the long run.
- The goal is to provide consultation beyond the normal consultative case, not to the individual physician but to the ward team. In this way, the pain service is more involved in the inpatient case and, in return, the team is more actively involved in pain management.
- In the best case scenario, the on-demand medications to be given in addition to the sustained-release opioids are a matter between the consultation service, the nursing staff, and the patient.
- Even the student body can be involved in this setting.
- This flattening of structures also increases the personal responsibility of the nursing staff as well as the trainees.

**Conclusion:**

Our own experience with a postoperative algorithm shows that a continuation of the administration or combination of NSAIDs / dipidolor not only for three (according to the previous recommendation) but for eight days postoperatively is possible and effective. For all other patients, an algorithm with sustained-release opioids and psychotropic drugs should be maintained. Adequate care of postoperative pain can only be achieved through the interprofessional involvement of nursing staff and the earliest possible low-threshold request for and continuation of care through pain consults with competence, some of which in a close-knit as well as intersectoral (partially outpatient) setting in accordance with the effective inpatient implementation of the pain therapy regime.
Nation-wide retrospective analysis of COVID-19 lock-down effect on non-malignant surgical procedures
ID: 173

René Fahrner*1, Eliane Dohner1, Simone Zwicky2, Fiona Kierdorf3, Claudio Canal4, Valentin Neuhaus4
1Bügerspital Solothurn, Schweiz, 2Inselspital Bern, Schweiz, 3Hôpital Morges, Schweiz, 4University Hospital Zürich, Schweiz

Background:
Coronavirus disease 2019 (COVID-19) is an acute virus infection, which was declared by the World Health Organization (WHO) as a pandemic. The Swiss government decreed a public lock-down to reduce and restrict further infections. The aim of this investigation was to analyze the impact of the first COVID-19 lock-down on the performance of general and visceral surgery procedures.

Materials and methods:
A retrospective study was performed on the basis of the prospective AQC data base (Swiss quality working group). All patients with specific surgical diagnosis (complicated gastric or duodenal ulcer, acute appendicitis, hernia, diverticular disease, gallstone disease, cutaneous and perianal abscess, and pilonidal sinus) were analyzed during 2019 (control group) and the corresponding lock-down period March 14 - April 26 2020. Data regarding patients’ characteristics, diagnosis, treatment and complications were analyzed.

Results:
In total 3330 patients were analyzed during the two corresponding time periods, with 2203 treated patients in 2019 and 1127 patients in 2020. There was a reduction in all investigated diagnosis with statistically significant differences in acute appendicitis, hernia, diverticular disease, gallstone disease, pilonidal sinus (all p<0.001), and cutaneous abscess (p=0.01). The proportion of complicated appendicitis (19.4% vs. 23.8%, p=0.02), complicated hernia (17.2% vs. 27.5%, p<0.001) and complicated gallstone disease (choledocholithiasis 8.7% vs. 14.1%, p=0.01, inflammation 64% vs. 75%, p=0.001) was significantly higher during the lock-down period. Regarding proportion of gender, mean age and length of hospital stay there were no significant differences between the two periods, whereas the ASA score was increased in case of hernia repair during the lock-down period (p<0.001), but not in other surgical diseases. The surgical urgency rate in all patients was higher during the lock-down period compared to the control period (45.5% vs. 68.2%, p<0.001) with statistically significant different urgency rates in patients with hernia repair (13% vs 76%, p<0.001), diverticular disease (34% vs 79%, p<0.001), gallstone disease (41% vs 65%, p<0.001), and pilonidal sinus (27% vs. 53%, p=0.01).

Conclusion:
In conclusion, the socio-economic lock-down significantly impacted the number of general and visceral surgery procedures, depending on the procedure with a reduction of up to 74%. The reasons for the reduction are multifactorial.
Acute appendicitis during the COVID-19 pandemic - changes in incidence and clinical presentation but not in patients' outcome

ID: 241

Sebastian Wolf*, Matthias Schrempf¹, Dmytro Vlasenko¹, Claus Schöler², Frank Erckmann³, Patrick von Parpart⁴, Rieke Paschwitz⁵, Matthias Anthuber¹, Florian Sommer¹

¹Klinik für Allgemein-, Viszeral- und Transplantationschirurgie, Universitätsklinikum Augsburg, Augsburg, Deutschland, ²Abteilung Allgemein- und Viszeralchirurgie, Wertachklinik Schwabmünchen, Deutschland, ³Klinik für Allgemein-, Viszeral und minimalinvasive Chirurgie, Klinik Donauwörth, Deutschland, ⁴Abteilung für Allgemein- und Viszeralchirurgie, Kliniken an der Paar, Aichach, Friedberg, ⁵Abteilung für Allgemein-, Viszeral-, Gefäß- und Thoraxchirurgie, Klinik Dillingen, Dillingen, Deutschland

Background:
The COVID-19 pandemic is an ongoing severe issue. The aim of this study was to compare the incidence, severity and treatment of acute appendicitis (AA) before and during the COVID-19 pandemic.

Materials and methods:
A retrospective cohort analysis was conducted between January 2019 and April 2020 in one high-volume center. A comparison was performed between two groups (group A: patients admitted with AA before the COVID-19 pandemic; group B: patients admitted with AA at the beginning of the pandemic) in terms of the incidence of AA and clinical and pathological outcomes. The incidence of AA was also analyzed in six surrounding peripheral hospitals.

Results:
A total of 94 patients were identified, 54 in group A and 40 in group B (57% vs. 43%). Demographic data was comparable between groups. AA in group B showed a significant higher rate of histological advanced cases (10 (18.5%) group A vs. 20 (50%) group B, p=0.001) and the need for postoperative antibiotic treatment (6 (11.1%) group A vs. 11 (27.5%) group B, p=0.045). During the pandemic, a higher percentage of patients was treated at peripheral hospitals (group A: 54/111 vs. 40/126).

Conclusion:
During the onset of the COVID-19 pandemic there was a significant decrease of patients with AA in a high-volume center, which showed more advanced disease of AA. This significant decrease in the high-volume center correlates with an increase in patients with AA in peripheral hospitals and represents a change in patient flow during the onset of the pandemic.
Cardiac Surgery for Infective Endocarditis After COVID-19 Infection: A Systematic Review and Clinical Series of an Underreported Threatening

ID: 517

Ali Waghefi*1, Asen Petrov1, Manuel Wilbring1, Konstantin Alexiou1, Ulz Kappert1, Klaus Matschke1, Sems-Malte Tugtekin1

1Herzchirurgie, Herzzentrum Dresden GmbH Universitätsklinik, Dresden, Deutschland

Background:
Infective endocarditis (IE) is associated with high morbidity and mortality, and its severity and incidence have not been improved by diagnostic and therapeutic advancements. IE is usually managed according to the conventional guidelines, particularly regarding the determination of the urgency of surgical treatment. However, the emergence of COVID-19 challenged the current guidelines for patients suffering from IE with recent or concomitant COVID-19 infection due to increased uncertainty regarding the optimal timing of diagnostic and therapeutic steps. We conducted a systematic review of the scientific literature adding a case series from our facility to analyze and sensitize to this challenging patient cohort in the ongoing COVID-19 pandemic.

Material and methods:
A Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guideline-conforming review was conducted searching PubMed database for reports published from June 20, 2020, to June 24, 2021, containing the terms “infective endocarditis” and “COVID-19.” A case series of eight patients from our facility was also added. Subsequently a descriptive analysis was conducted.

Results:
A total of four studies were included comprising four case reports that met our inclusion criteria in addition to a case series of eight patients from our facility. Patients were 60.5 ± 17.2 years of age (median = 67.0 years) and predominantly male (92.3%). Three (25.0%) patients had undergone previous cardiac surgery. The mean EuroSCORE II mortality index was 21.0% ± 18.0%. mean LVEF was 51.9% ± 7.25%. The mean body mass index was 31.3 ± 6.78; Notably, 87.5% (n = 7) of patients had a BMI ≥ 25 kg/m². Among all patients evaluated in this study, dyspnea (n = 8, 66.7%) was the leading symptom, followed by fever (n = 7, 58.3%). Sepsis was manifest in 75% of all patients (n = 9), and 16.7% (n = 2) of patients in our case series suffered septic shock with consecutive preoperative use of a vasopressor. Preoperative ventilation was indicated in 16.7% (n = 2) of all patients. The mean time interval from COVID-19 initial diagnosis (either positively detected by RT-PCR or antigen test) to a definitive diagnosis of IE by detection of vegetations in (TEE) was 59.9 ± 68.2 days in both IE patients with concomitant and recent COVID-19 infection. 25.0% (n = 3) suffered from a bivalve IE, while the rest had a single valve affection. Prosthetic valve endocarditis was identified in 16.7% (n = 2) of cases, while the remainder of IE involved native valves. E. faecalis and S. aureus caused 75.0% (n = 9) of IE cases associated with concomitant or recent COVID-19 infection. The mean time-to-surgery was 17.7 ± 14.4 days in IE patients with concomitant (n = 3) COVID-19 infection and 13.0 ± 20.6 days in IE patients with recent (n = 6) COVID-19 infection, respectively. In-hospital and 30-day mortality for all evaluated patients was 16.7% (n = 2). In our case series, all postoperatively discharged patients (n = 6, 75.0%) were still alive at the first six-month follow-up.

Conclusion:
IE requiring surgical treatment complicated by concomitant or recent COVID-19 infection is a relatively underreported aspect of the global pandemic. Hence, there is limited evidence from the literature on the management of this challenging patient cohort. On the one hand, since patients affected by COVID-19 infection frequently present with fever and dyspnea, which overlaps with IE symptoms, clinicians must
carefully assess patients diagnosed with COVID-19 to prevent missing underlying disease. On the other hand, if IE is suspected, clinicians should avoid postponement of crucial diagnostic and treatment steps with the idea to prevent the risk of SARS-CoV-2 spread to medical personnel, as delay in diagnosis and treatment management of IE may cause significant morbidity and mortality.
Persistent procalcitonin elevation after Covid-19 disease - differential diagnosis: medullary thyroid cancer

ID: 613

Frederike Butz*, Agata Dukaczewska¹, Eva Maria Dobrindt¹, Johann Pratschke¹, Peter Goretzki¹, Martina Mogl¹

¹Department of Surgery, Campus Charité Mitte | Campus Virchow-Klinikum, Charité - Universitätsmedizin Berlin, Berlin, Deutschland

Background:
Medullary thyroid cancer (MTC) that develops from the parafollicular C-cells, represents about 5% of all thyroid cancer and has an incidence of 0.4 to 0.7 per 100,000 population. It produces procalcitonin (PCT) that is converted into calcitonin. Calcitonin is the most sensitive and specific tumor marker used in detection and monitoring of MTC. Elevated PCT also occurs during systemic inflammations, especially bacterial infections, and is a commonly used biomarker for diagnostics and therapy monitoring – also during Covid-19 diseases.

Materials and methods:
We present two cases of two 35-year-old patients that both showed persistent PCT elevation after recovery from Covid-19 pneumonia which finally led to diagnosis of MTC.

Results:
Both 35-year-old patients presented with persistent PCT-elevation after recovery from bilateral Covid-19 pneumonia, that did not decrease despite antibiotic treatment of suspected bacterial superinfection. No pulmonary symptoms were reported, there were no other clinical signs of infections and the pursued diagnostics did not show any infectious cause.

In suspicion of a paraneoplastic genesis, calcitonin and CEA were measured and showed a pathological elevation in both cases. The subsequent pursued imaging diagnostics demonstrated thyroid tumors suspicious for malignancy in both patients and a large tumor of the right adrenal gland in the second patient with no signs of distant metastasis. After surgical resection, histopathology confirmed the diagnosis of medullary thyroid cancer in both patients and an additional pheochromocytoma in the second patient. Genetic testing revealed the MEN2a-syndrom.

Conclusion:
PCT monitoring during and after Covid-19 disease is a common and important diagnostic tool. The here-presented cases clearly demonstrate that in the event of elevated procalcitonin levels, after exclusion of an infectious etiology, a neoplasia must be considered, too.
The impact of the SARS-CoV-2 pandemic on emergency surgery - an international survey

ID: 938

Martin Reichert*, Massimo Sartelli1, Markus A. Weigand3, Christoph Doppsadt†, Matthias Hecker4, Alexander Reinisch-Liese5, Fabienne Bender1, Ingolf Askevold1, Winfried Padberg1, Federico Coccolini6, Fausto Catena7, Andreas Hecker1

1Klinik für Allgemein-, Viszeral-, Thorax-, Transplantations- und Kinderchirurgie, Universitätsklinikum Gießen, Gießen, Deutschland 2Department of Surgery, Macerata Hospital, Macerata, Italia 3Klinik für Anästhesie, Universitätsklinikum Heidelberg, Heidelberg, Deutschland 4Medizinische Klinik II, Universitätssklinikum Gießen, Gießen, Deutschland 5Klinik für Allgemeine, Viszeral- und Onkologische Chirurgie, Lahn-Dill-Kliniken Wetzlar, Wetzlar, Deutschland 6Department of General, Emergency and Trauma Surgery, Pisa University Hospital, Pisa, Italia 7Department of Emergency Surgery, Parma Maggiore Hospital, Parma, Italia

Background:
The SARS-CoV-2 pandemic is a major challenge for health care services world-wide. The impact of the pandemic on oncologic therapies and elective surgery has been described recently and the literature provides guidelines regarding appropriate elective patient treatment during the pandemic. However, this survey investigates the word-wide impact of the SARS-CoV-2 pandemic on emergency surgery services.

Materials and methods:
A 17-item web-survey had been distributed to emergency surgeons in June 2020 around the world, investigating the impact of SARS-CoV-2 pandemic on patients and septic diseases both requiring emergency surgery, on the time-to-intervention in the daily emergency surgery routine. Furthermore, the experiences with surgery in COVID-19 patients at this early time point of the pandemic were investigated.

Results:
98 collaborators from 31 countries responded to the survey. The majority (65.3%) estimated the impact of the SARS-CoV-2 pandemic on emergency surgical patient care as being strong or very strong. Due to the pandemic, 87.8% reported a decrease in the total number of patients undergoing emergency surgery and approximately 25% estimated a delay of more than 2 hours in the time-to-diagnosis and another 2 hours in the time-to-intervention. 50% make structural problems with in-hospital logistics (e.g. transport of patients, closed normal wards et cetera) mainly responsible for delayed emergency surgery and the frequent need (56.1%) for a triage of emergency surgical patients. 56.1% of the collaborators observed more severe septic abdominal diseases during the pandemic, especially for perforated appendicitis and severe septic cholecystitis (41.8 and 40.2%, respectively). 62.2% had experiences with surgery in COVID-19 infected patients.

Conclusion:
The results of The WSES COVID-19 emergency surgery survey are alarming. The combination of an estimated decrease in numbers of emergency surgical patients and an observed increase in more severe septic diseases may be a result of the fear of patients from infection with COVID-19 and a consecutive delayed hospital admission and diagnosis. A critical delay in time-to-diagnosis and time-to-intervention may be a result of changes in in-hospital logistics and operating room as well as intensive care capacities. Both reflect the potentially harmful impact of SARS-CoV-2 pandemic on emergency surgery services in 2020.
Currently, we are ongoing to investigate persistent alterations of daily routine in emergency surgery and persistent obstacles in emergency surgical patient treatment due to the pandemic and the SARS-CoV-2 DELTA wave with our world-wide collaborators.
Quality of life in patients after resection of retroperitoneal soft tissue sarcoma
ID: 574

Lena Buck*, Franziska Willis†, Martin Schneider†
†Universitätsklinik Heidelberg, Klinik für Allgemein-, Viszeral- und Transplantationschirurgie, Heidelberg, Deutschland

Background:
Retroperitoneal soft tissue sarcoma (RPS) are rare and heterogeneous tumors and account for ~1 % of malignancies in adults. Surgery is the mainstay in RPS treatment since, besides tumor biology such as grading and histological subtype, macroscopic complete resection is the most important prognostic factor for improved overall survival. To minimize the probability of tumor-infiltrated resection margins, compartmental resection has become a standard technique for RPS resection. This approach includes resection of all organs and structures adjacent to the tumor which is why multivisceral resection is often necessary. Nonetheless, local recurrences and distant metastases are frequent in RPS and constitute a major problem in clinical management. It has been shown that repeated surgery for RPS recurrence, including multivisceral resection, is associated with improved overall patient survival and is acceptable in terms of morbidity and mortality, but the impact on patients’ quality of life (QoL) has been scarcely investigated. In this study we aim to access and analyze postoperative QoL after resection and re-resection of RPS regarding physical as well as emotional and social components.

Materials and methods:
All patients who underwent resection of primary, recurrent or metastasized RPS at the University of Heidelberg Department of General, Visceral and Transplantation Surgery between October 2001 and December 2020, who were alive, were included in this study. Six questionnaires to access physical and psychosocial components of QoL were sent to all patients by post. For the assessment of postoperative quality of life, 5 already validated questionnaires (EORTC QLQ-C30, PRO-CTCAE, WEMWBS, PA-F-KF and PC-PTSD) and one self-developed questionnaire for the assessment of QoL depending on the number of operations were used. Returned questionnaires were descriptively analyzed and correlational analyses were performed to investigate the relation between postoperative QoL and patient as well as treatment characteristics such as age, ASA score, number of operations and postoperative complications.

Results:
We received questionnaires from 127 out of 180 contacted patients. 44 % of all patients only had one tumor resection, 19% were operated twice, 9% had three, 7 % had four, 5% had five and 12 % more than five tumor resections. Emotional and social components of quality of life were more affected than physical components: 29 % of all patients reported no limitations on QoL due to physical limitations and 31 % reported only mild limitations, whereas over 80% of all patients showed signs of a possible depression and average mental well-being was only attributed to 6% of all patients. Lower general QoL, assessed with the EORTC QLQ-C30 global health score, correlated with a higher number of tumor resections (p = 0,014). There was no correlation between reduced general, physical or social functioning and the occurrence of postoperative complications (all p > 0,05).

Conclusion:
In everyday surgical practice, besides sufficient oncological treatment, the focus is mainly set on physical recovery and postoperative complications. However, our results show that QoL seems to be more affected by psychosocial than physical limitations. Therefore awareness for possible psychosocial impairments and concomitant psychooncological care may further improve long-term postoperative QoL.
Multimodal Treatments and their Impact on Perioperative Morbidity following Radical Resection of Retroperitoneal Sarcoma

ID: 807

Markus Albertsmeier*, Andreas Hofmann†, Cathy Werdel†, Yanik Arlt†, Martin Angele†, Jens Werner†
†LMU University Hospital, Department of General, Visceral and Transplantation Surgery, Munich, Deutschland

Background:
Radical surgery is the treatment of choice for resectable retroperitoneal soft tissue tumours (retroperitoneal sarcoma, RPS). This usually requires multivisceral resections that bear an elevated risk of perioperative morbidity. To further improve local and systemic tumour control, multimodal treatment protocols have been established. These may include radiotherapy, chemotherapy, and regional hyperthermia (RHT) in some centres. Given the limited evidence on the safety and effectiveness of such concepts, we investigated the influence of neoadjuvant therapies on perioperative morbidity in RPS. The Comprehensive Complication Index (CCI) is a tool that precisely captures perioperative morbidity but has never been validated in a cohort of RPS patients.

Materials and methods:
This retrospective study included patients who had curative-intent surgery for RPS at LMU University Hospital between 2003 and 2019 and for whom a core set of clinical data was available. We recorded clinical characteristics, neoadjuvant therapies, and perioperative complications. The CCI was calculated for all patients and analyzed in a zero-one inflated beta model for possible risk factors.

Results:
We included 128 patients (70 male, 58 female; mean age 58.8 [SD 13.0]) in the analysis. The main histotypes were dedifferentiated liposarcoma (41%), well-differentiated liposarcoma (24%), leiomyosarcoma (17%) and undifferentiated pleomorphic sarcoma (9%). Forty-nine patients received the combination of chemotherapy + RHT, 40 patients had radiotherapy, and of these, 28 patients had all three treatments combined. The CCI was increased for patients with neoadjuvant radiotherapy (median 33.5 [25% - 75%: 20.9 - 47.5] vs. 8.7 [0 - 33.5]) and for those who had chemotherapy + RHT (33.5 [20.9 - 43.6] vs. 8.7 [0 - 29.9]) compared to patients without neoadjuvant treatment, respectively. In the zero-one inflated beta model for the occurrence of any complication (CCI > 0), we observed a significant influence of transfusion requirements (RR 1.32 [95% CI: 1.05 - 1.72], p = 0.02) and resection of ≥ 3 organs (RR 1.37 [1.01 – 1.98], p = 0.044), whereas for neoadjuvant therapies (RR 1.16 [0.98 – 1.45], p = 0.09) such a relationship could not be statistically confirmed. We found no significant differences between different neoadjuvant protocols.

Conclusion:
Patients with RPS have more frequent or more intense perioperative complications following intensive neoadjuvant treatments. Nonetheless, surgical factors such as the extent of resection and transfusion requirements determine short-term outcomes. In the interdisciplinary discussion of neoadjuvant therapies, however, their association with perioperative complications should be considered.
Tumor cell purging of intraoperative salvaged blood with Catuvab - a new concept in perioperative blood management
ID: 841

Niklas Weltermann*1, Markus Maria Heiss1, Kai Zacharowski2, Andreas Schnitzbauer3
1Klinikum Merheim, Kliniken der Stadt Köln, Klinik für Viszeral-, Tumor-, Transplantations- und Gefäßchirurgie, Köln, Deutschland, 2University Hospital Frankfurt, Department of Anaesthesiology, Intensive Care Medicine and Pain Therapy, Frankfurt am Main, Deutschland, 3University Hospital Frankfurt, Department of General and Visceral Surgery, Frankfurt am Main, Deutschland

Background:
Intraoperative blood salvage (IBS) is regarded as an alternative to allogeneic blood transfusion excluding the risks associated with allogeneic blood. Currently, IBS is generally avoided in tumor surgeries due to concern for potential hematogenic dissemination of residual tumor cells in the salvaged erythrocyte concentrate.

Materials and methods:
The feasibility, efficacy and safety aspects of the new developed Catuvab procedure using the bispecific trifunctional antibody Catumaxomab were investigated in an ex-vivo pilot study in order to remove residual EpCAM positive tumor cells from the autologous erythrocyte concentrates (EC) from various cancer patients, generated by an IBS device employed during tumor surgery.

Results:
Tumor cells in intraoperative blood were detected in 10 of 16 patient samples in the range of 69 - 2.6x10^5 but no residual malignant cells in the final erythrocyte concentrates after Catuvab procedure. IL-6 and IL-8 as pro-inflammatory cytokines released during surgery, were lowered in mean 28-fold and 52-fold during the Catuvab procedure, respectively, whereas Catumaxomab antibody was detected in 8 of 16 of the final EC products at a considerable decreased and uncritical residual amount (37 ng in mean).

Conclusion:
The preliminary study results indicate efficacy and feasibility of the new medical device Catuvab allowing potentially the reinfusion of autologous erythrocyte concentrates (EC) produced by IBS device during oncological high blood loss surgery. An open-label, multicenter clinical study on the removal of EpCAM-positive tumor cells from blood collected during tumor surgery using the Catuvab device to validate these encouraging results is currently recruiting.
High grade of interdisciplinarity defines resectability of retroperitoneal sarcomas - a center report

ID: 1029

Frederike Butz*, Tomasz Dziodzio1, Brigitta Globke1, Klaus Pietzner2, Sarah Weinberger3, Joerg Neymeyer4, Safak Gül1, Friederike Martin1, Sophie Reichelt5, Christian Witzel6, Sven Märdian7, Armin Jarosch8, Silvan Wittenberg7, Franziska Brandes9, Stefan Pahl10, Frederik Maximilian Schäfer10, Jalid Sehouli2, David Kaul11, Daniel Rau2, Beate Rau3, Anne Flörcken9, Johann Pratschke5, Robert Öllinger5,


Background:
Surgical resection is the only curative option for patients with retroperitoneal sarcoma. Irresectability, by the means of improbability of R0 resection, depending on tumor size, localization and infiltration of surrounding structures, is given in 10-25% of the cases. We herein describe 6 cases of extensive surgical cases that previously were declared irresectable. Our approach, how to address this rare entity based on the progress made in recent years, included up-to-date diagnostics, neoadjuvant treatment and multidisciplinary surgical approaches.

Materials and methods:
Retrospective analysis of patients from January 2020 until September 2021 with retroperitoneal sarcomas deemed previously irresectable involving each one liposarcoma, desmoplastic round cell tumor, leiomyosarcoma, recurrent teratoma, recurrent renal ewing sarcoma and endometrial stromal sarcoma. Primary endpoint was R0 resection, secondary endpoints were peri- and postoperative complications.

Results:
In all cases R0 resection was achieved. 3 Cases required vascular resection and reconstruction. All resections required more than one discipline involving visceral surgery, vascular surgery, gynecology, urology and traumatology. In the postoperative course, one patient had a Clavien-Dindo IIIb complication, all others had no complications or ≤ Clavien-Dindo II.

Conclusion:
Retroperitoneal sarcomas require treatment in a specialized centre. Although tumor anatomy can be challenging, excellent surgical results can be achieved when approaching the resection in an interdisciplinary surgical team. After careful evaluation and planning, irresectable deemed cases may become R0 resectable.
Temperature Profile and Residual Heat of Monopolar Laparoscopic Dissection Instruments - Risk Analysis and Recommendation For a Safe Application

ID: 364

Alexander Hendricks*, Frank Schwandner¹, Sebastian Hinz¹, Clemens Schafmayer¹, Jochen Hampe², Andreas Richter³, Franz Brinkmann²

¹Universitätsmedizin Rostock, Rostock, Deutschland, ²Universitätsklinikum Dresden: Medizinische Klinik I, Dresden, Deutschland, ³TU Dresden, Institut für Halbleiter und Mikrosysteme, Dresden, Deutschland

Background:
The application of laparoscopic electrosurgical devices (ED) is commonly utilised in modern surgical approaches and hence of great importance. However, they can potentially cause severe adverse events such as tissue injuries and burns due to residual heat. Our aim is to investigate the temperature and the residual heat of laparoscopic monopolar instruments to potentially increase safety in handling and to provide a reference to ensure safe use.

Materials and methods:
In this investigation a high precision infrared camera was implemented to measure the temperature of laparoscopic instruments during energy application and to determine the cooling time to below 50 °C (which is considered to be harmless to adjacent tissue) at a porcine stomach ex vivo. Diverse power levels and cutting intervals were studied to investigate their impact on the instrument’s temperature profile.

Results:
During initial activation, the laparoscopic hook regularly exceeded 120 °C (max 255 °C at the tip) with a shaft length of up to 10 mm. The residual heat of the laparoscopic hook remained above 50 °C for at least 15 s after activation. Temperatures < 50 °C were only observed 20 seconds after the energy was added. A higher power level and longer cutting time increased the shaft temperature considerably and prolonged the cooling time (Tip, effect 5: 15.2±7.9 s vs. effect 7: 34.4±5.5 s vs. effect 10: 35.8±5.6 s, p < 0.001; 0 mm, 5 mm, 10 mm).

Conclusion:
The residual heat and maximum temperature amplitude considerably depend on the chosen effect and cutting duration. To avoid possible adverse events such as collateral tissue damage, our data strongly suggest that unnecessary tissue contact must be avoided for at least 15 seconds after the application of energy—at least for vulnerable tissues. As the shaft also heats up to over 120 °C, the surgeon should take care to avoid tissue contact during instrument activation.
Effects of structured intraoperative briefings on patient outcomes: A multicentric before and after study
ID: 66
Franziska Tschan1, Norbert Semmer2, Jasmin Zimmermann1, Eliane Holzer-Timm1, Martin Hübner3, Daniel Candinas4, Nicolas Demartines3, Markus Weber5, Guido Beldi∗4
1University of Neuchâtel, Institute for Work and Organizational Psychology, Neuchâtel, Schweiz, 2University of Bern, Department of Psychology, Schweiz, 3Department of Visceral Surgery, University Hospital Lausanne (CHUV), Lausanne, Schweiz, 4Bern University Hospital, University of Bern, Department of Visceral Surgery and Medicine, Bern, Schweiz, 5Department of Surgery, Triemli Hospital, Zürich, Schweiz

Background:
Operations require collaboration by surgeons, anesthesia and nurses. Aim was to determine whether intraoperative briefings influence patient outcomes.

Materials and methods:
In a before-and-after controlled trial (nine-month baseline; nine-month intervention), intraoperative briefings were introduced in four general-surgery centers between 2015 and 2018, including 8256 adult patients. During the operation, the responsible surgeon (most senior surgeon present) briefed the surgical team using the StOP? protocol about: progress of the operation (Status), next steps (Objectives), possible problems (Problems), and encouraged asking questions (?). Differences between baseline and intervention were analyzed regarding surgical site infections (primary outcome), mortality, unplanned reoperations, and length of stay (secondary outcomes), using inverse probability of treatment weighting based on propensity scores.

Results:
End-point data were available for 7745 (93.8%) patients. ITPW weighted and adjusted intention-to-treat analyses showed no differences for surgical site infections between baseline (9.75%) and intervention (9.59%); (adjusted difference (AD) -0.15%, 95% confidence interval (CI) -1.45 to 1.14; odds ratio (OR) 0.92, CI 0.83 to 1.15; P=0.797), but reductions in mortality (1.59% vs. 1.05%; AD -0.54%, CI -1.039 to -0.033; OR 0.60, CI 0.39 to 0.92; P=0.018), unplanned reoperations (6.44% vs. 4.79%; AD -1.66%, CI -2.69 to -0.62; OR 0.72, CI 0.59 to 0.89; P=0.002), and prolonged hospital stays (21.64% vs. 19.82%; AD -1.82%, CI -3.48 to -0.15; OR 0.87, CI 0.77-0.98; P=0.024).

Conclusion:
The intervention yielded no change in surgical site infection rates, but was related to a reduction in mortality, unplanned reoperations, and length of stay. Short intraoperative briefings should be considered during operations.
Effect of Prevena V.A.C. therapy on lymphocele and lymphorrhea after inguinal and axillary lymph node dissection
ID: 153

Anna Wöstemeier*, Irene Fioravanti1, Gun-Soo Hong1, Azin Jafari1, Jörg C. Kalfi1, Philipp Lingohr1
1Klinik und Poliklinik für Allgemein-, Viszeral-, Thorax- und Gefäßchirurgie, Universitätsklinikum Bonn, Bonn, Deutschland

Background:
Lymph node dissection, either axillary (ALND) or inguinal (ILND), plays an important role in the therapy and prognosis of metastatic cancers, such as malignant melanoma (MM). Despite intraoperative measures, i.e. ligation or coagulation of lymphatic vessels, postoperative lymph fistulas still constitute a major challenge. Vacuum-assisted wound closure (V.A.C) therapy can cause initial oedema reduction leading to improved perfusion and consequent healing potential. In this retrospective analysis the benefit of Prevena V.A.C. Therapy regarding lymphatic complication after ALND and ILND was investigated.

Materials and methods:
162 oncological patients who underwent ALND or ILND at the University Hospital Bonn (Department for General, Visceral-, Thoracic and Vascular Surgery) were retrospectively enrolled. Patients were grouped according to ALND or ILND and further divided between patients with and without postoperative V.A.C. treatment. Statistical analyses were performed to investigate the impact of V.A.C therapy on postoperative lymphatic complications.

Results:
The study included 92 patients who underwent ALND and 70 patients with ILND. VAC therapy was applied for 47% (ALND) and 46% (ILND) of all patients. Overall, operation time was significantly higher in patients treated with V.A.C. therapy compared to no V.A.C. therapy (ALND: p < 0.001, ILND: p =0.014). However, patients treated with and without V.A.C. therapy showed similar occurrence rates for lymphatic complications, such as lymphocele and lymphorrhea.

Conclusion:
This is the first study analyzing Prevena V.A.C. therapy in patients after ALND and ILND. Overall, V.A.C. therapy appears unfavorable in ALND and ILND patients, as it lengthens operation times, increases management costs and does not lead to reduced lymphocele formation and lymphorrhea volume.
High voltage injuries by contact with overhead lines: case reports of two young girls

ID: 288

Betül Günal¹, Filipp Sokolovski²*, Nikolaus Neu², Anton Schwabegger², Tatjana König¹, Veronika Engel¹, Oliver Muensterer³
¹Klinik und Poliklinik für Kinderchirurgie, Universitätsmedizin der Johannes Gutenberg-Universität Mainz, Mainz, Deutschland, ², Medizinische Universität Innsbruck, Österreich, ³Kinderchirurgische Klinik und Poliklinik, Dr. von Haunersches Kinderspital, München, Deutschland

Background:
High voltage burn injuries are rare in the pediatric age group, but can lead to devastating, severe sequelae. We present the unusual cases of a 10- and a 14-year-old girl with high voltage injuries after direct contact with overhead electrical lines, along with their complex hospital course, psychosocial background, and the implications for future preventative strategies.

Case Reports:
Case 1: A 10-year-old girl was playing with friends in an unsecured area in which trains were normally parked for scrapping. The child climbed onto the roof of a train engine and inadvertently came in contact with a 15 kiloVolt (kV) overhead line. 40 % of her total body surface area (TBSA) showed second to third degree burns. The electric entry mark was on the left hand, the exit mark was noted on the right foot. The right fifth toe was amputated. She required several rounds of split-thickness skin grafting to close the affected areas. In the long-term, she developed severe contracture of the left elbow and shoulder, as well as dorsal contracture of the right foot. The patient had complicated family structures and lived under adverse psychosocial circumstances; intermittently she was lost to follow-up. She was eventually taken into foster care and placed into a residential group.

Case 2: A 14-year-old girl presented with severe electric burn injuries after climbing a 15 kV pylon in suicidal intention. She grabbed the overhead line with both hands and then fell to the ground. 10 % of the TBSA were burned, predominantly involving both arms and the left thigh. The distal right lower arm was skeletonized. An exit mark was identified on the right ankle. Fasciotomies were performed on both arms and the distal right arm was amputated. The stump of the right arm required revision due to progressive necrosis of the distal tissues and closure with a myocutaneous flap. On follow-up 20 months after discharge, the right arm stump appeared in good condition, and she had severe contraction of the fingers of the left hand. She suffered from a difficult psychosocial situation as her parents got divorced recently; in addition, she reported frequent and severe bullying at school.

Conclusion:
High voltage electric burns in children are uncommon but mostly result in complex injuries associated with high morbidity. Adverse psychosocial circumstances are a significant risk factor for such incidents in children and adolescents. Multidisciplinary treatment in a high-volume pediatric burn center is mandatory and may optimize the outcome.
Waste Management in the operating room: Status quo and opportunities for more sustainability

Alexander Reinisch-Liese*, Juliane Liese, Frank Ulrich

1Zentrum für Allgemeine, Viszeral- und Onkologische Chirurgie, Klinikum Wetzlar, Wetzlar, Deutschland, 2Klinik für Allgemein-, Viszeral-, Thorax-, Transplantations- und Kinderchirurgie, Universitätsklinikum Gießen, Gießen, Deutschland

Background:
Hospitals are the fifth largest garbage producer in Germany. Only 3% of hospital waste is medical waste that requires special disposal. Especially in the operating room (OR), there are large amounts of clean recyclable materials, such as outer packaging. We examined waste management and recycling options in the OR using the example of laparoscopic appendectomy (LA).

Materials and methods:
In a representative, ongoing survey, 332 hospitals with general surgery departments were asked about their waste management in the OR. Second, it was determined for the LA which materials are used and which proportion of substances are theoretically recyclable. This data was verified prospectively in everyday clinical practice by collecting recyclable materials separately in 15 LA compared with 15 LA without separation of recyclables.

Results:
So far, answers have been received from 84 clinics (response rate 25.3%). In 73.8% of the hospitals there is no waste separation at all. Clinics collecting recyclables separate plastics (100%) and cardboard (100%), as well as metal (45%) and others (27%).

The theoretical analysis of the materials required for a laparoscopic appendectomy (LA) showed that a total of 1095 g of recyclable materials can be neatly separated from the total waste weight of 5265 g during the preparation and the course of the operation (395 g polyethylene terephthalate (PET) and polypropylene, 100 g high-density polyethylene fibers (Tyvek®) as well as 445 g paper/cardboard).

In practice, the comparison of 15 LA with separation of recyclables with 15 LA without separation showed that an average of 960 g (340 g - 2050 g) recyclables could be separated: 470 g (115 g - 1100 g) plastics, of which > 80% PET and 490 g (225 g - 1100 g) paper/cardboard. This corresponded to approx. 12.8% of the total waste weight, corrected for liquids (mainly irrigation), a recycling rate of 17.8% could be achieved. The total waste weights, the preparation, operating time and the proportion of LA with irrigation did not differ significantly between the operations with and without separation of recyclables.

Conclusion:
Our study demonstrates great possibilities for reducing residual waste and recovering valuable materials in the OR: In particular, large quantities of paper and high-quality plastics such as clear PET can be recycled. Using LA as an example gives options of extrapolation: With about 108,000 LA per annum and assuming that only 26% of the clinics separate recyclables, a reduction of residual waste by about 53 tons can easily be achieved. Looking at other operations and to other surgical disciplines this demonstrates great possibilities for a more sustainable waste-management in the OR. It is of particular importance here that, according to our data, the separation of recyclables does not lead to any delays in the course of the operation.
Cytoreductive surgery and Hyperthermic intraperitoneal chemotherapy (HIPEC) for the treatment of abdominal soft tissue sarcomas

ID: 181

Friederike Riotte*1, Jens Strohäker1, Robert Bachmann1, Ruth Ladurner1, Anke Meier1

1Universitätsklinikum Tübingen; Klinik für Allgemeine, Viszeral- und Transplantationschirurgie; Tübingen; Deutschland

Background:
Abdominal soft tissue sarcomas are rare tumor entities that occur in both adults and children. The gold standard of treatment is complete resection often followed by adjuvant treatment. Unfortunately disseminated systemic tumor recurrence is common, leaving most patients to palliative treatment. Isolated peritoneal recurrence is rare and given the already infrequent response of sarcomas to systemic treatment, therapeutic options are limited. Hyperthermic intraperitoneal chemotherapy (HIPEC) in combination with complete surgical cytoreduction uses a high concentration of a chemotherapeutic agent in combination with hyperthermia to achieve the highest possible locoregional cytotoxicity while avoiding systemic chemotherapy-related morbidity. The therapy was shown to be effective in other tumor entities in several retrospective studies, in terms of tumor-free and overall survival. Data for sarcomas however is scarce. Unlike carcinomatosis which shows infiltrating growth patterns, sarcoma recurrence tends to be nodular on the surface of the abdominal organs, so completeness of cytoreduction (CC-status) can frequently be achieved and local chemotherapy is thought to be more effective.

Materials and methods:
At the University Hospital of Tuebingen 16 patients were treated with cytoreduction and HIPEC between 2010 and 2021. Four pediatric patients (age range 18 months - 7 years) were surgically treated by the department of pediatric surgery. Twelve patients (ten females, two males) were a median of 43 years old (range 22 - 74). The treated tumor entities were rhabdomyosarcoma (n = 2), leiomyosarcoma (n = 2), carcinosarcoma (n = 2), endometrial stromal sarcoma (n = 2), desmoplastic round cell tumor (n = 2), granulosa cell tumor (n = 2), and one patient each had a fibrosarcoma and an embryonal sarcoma. Our team performed HIPEC for all 16 patients. Considering intraoperative chemotherapy 12 patients were treated with cisplatin and doxorubicin intraabdominally; three of four pediatric patients received cisplatin only and one adult received doxorubicin / ifosfamide because of a known allergy to intravenous cisplatin.

Results:
The peritoneal carcinomatosis index according to Sugarbaker assessed during cytoreductive surgery ranged from 3 to 24, with a median of 13. A completeness of cytoreduction CC0 status was achieved in 12 patients. In the remaining patients a CC1 situation was achieved. In eight patients the resection status was histopathologically reported as R0. Nine of the twelve patients that had a CC0 status developed recurrence during follow-up including five patients that had R0 resection. With regards to curation the combination of CCO and R0 proved to be optimal. Patients with cytoreduction and HIPEC had a median ICU stay of 2.9 days, and the overall inpatient stay was 17.5 days. Considering the postoperative complications, only five of the 16 patients were free of complications, in 11 patients the complication grade according to Clavien-Dindo was between I and IV (grade I = 3, grade II = 4, grade III = 3 and grade IV = 1).

Conclusion:
Cytoreductive surgery with HIPEC is a feasible therapeutic option for patients with isolated peritoneal recurrence of soft tissue sarcomas. Whether HIPEC adds to survival benefit multicentric trials with uniform chemotherapeutic agents are desired. However, due to the nonetheless rare and inhomogenous
tumor entities they are hard to ever complete and therefore treatment will continue to be based on large case series
Post-relapse outcome of retroperitoneal soft tissue sarcoma
ID: 373
Franziska Willis*, Martin Schneider
1 Universitätsklinikum Heidelberg, Klinik für Allgemein-, Viszeral- und Transplantationschirurgie, Heidelberg, Deutschland

Background:
Local recurrences (LR) and distant metastases (DM) are common in retroperitoneal soft tissue sarcoma (RPS). In primary tumors, predictors of recurrence-free and overall survival (OS) comprise histological subtype, grading, and completeness of resection. Upon first tumor relapse longer time to recurrence and resection of the recurrent lesion have been identified as beneficial prognostic factors for OS. However, evidence concerning prognostic factors upon subsequent recurrences is scarce. In this study we analyzed post relapse outcome in multiple recurrent RPS.

Materials and methods:
Patients undergoing resection of primary and recurrent RPS at the University of Heidelberg Department of General, Visceral and Transplantation Surgery were retrospectively analyzed. Univariable Kaplan-Meyer and multivariable Cox regression analyses were performed to identify predictors of overall, LR- and DM-free survival. Subgroup analyses were performed in the two predominant histological subtypes liposarcoma and leiomyosarcoma.

Results:
201 patients with primary disease, 101 patients with first, 66 patients with second and 43 patients with third LR as well as 75 patients who developed DM were analyzed. Occurrence of both LR and DM was associated with poor OS. More than 12 months to recurrence and complete resection of recurrence were independent prognostic factors for improved OS after resection of first and second LR (5-year OS for first/second LR; resection: 64%/62%, no resection: 20%/46%). Gross macroscopic incomplete resection of first (p < 0.001), second (p = 0.001), and third recurrences (p < 0.001) were associated with poor OS.

Conclusion:
Development of LR and DM is frequent in RPS and is associated with reduced OS. Once a tumor relapse patients benefit from tumor resection not only in case of first, but also in case of subsequent recurrences.
Surgically treated retroperitoneal sarcoma: comparison of postoperative complications data and long term survival

ID: 733

Robert-Richard Ridwelski*, Frank Meyer

1 Universitätsklinikum Magdeburg, Abteilung für Kinderchirurgie, Magdeburg, Deutschland, 2 Universitätsklinikum Magdeburg, Universitätsklinik für Allgemein- Viszeral- Gefäß- und Transplantationschirurgie (KCHI), Magdeburg, Deutschland

Background:
Retroperitoneal sarcomas (RPS) are rare tumor lesions, with a wide range of histopathological presentation which define the type of diagnostic and therapeutic management as well as the course of disease.

In particular, the histopathological subtype is decisive for the surgical planning, due to different sarcoma biology. A complete surgical resection of primary non-metastatic retroperitoneal sarcomas is basically the only potentially curative treatment. The aim of surgical intervention is an en-bloc resection with negative tumor margins. Due to the primary size of the sarcomas and their position in the retroperitoneum, en-bloc R0 resection can usually frequently only be achieved with a multivisceral resection. The principle of retroperitoneal compartment resection became established in the late 2000s. Nevertheless, local tumor recurrence continues to be the most common cause of tumor-associated death in this malignant tumor entity.

Aim: To investigate early postoperative (characterized by morbidity and mortality) as well as long-term oncological outcome in a representative consecutive patient cohort with RPS of two tertiary centers of abdominal surgery for quality assurance and to reflect daily clinical practice as a contribution of research on clinical care.

Materials and methods:
We carried out a two-center systematic clinical retrospective observational study (design) with the Magdeburg University Hospital and the Magdeburg Municipal Hospital representing the tertiary center abdominal surgery profile.

Data of all consecutive patients surgically treated from March 1993 to March 2009 for RPS were extracted from surgical databases. A long-term follow-up examination was then carried out over a period of 10 years until March 2019. Clinicopathologic variables and the outcome of the patients with primary RPS were analyzed including their impact on outcome measures.

Results:
In total, 74 patients were included in the study, 60 patients with primary RPS and 14 with local recurrence. All patients with local recurrence where treated at the University Hospital of Magdeburg. Out of the 60 patients with primary RPS, 15 (25 %) presented to the Magdeburg Municipal Hospital. Median age for patients with primary RPS was 60.5 (range; 27-87) years. The gender distribution was almost even (male: n=27, 45 %). Almost half of all 60 primary RPS patients presented with a liposarcoma, 45 % (n = 27), the second most common sarcoma entity was the leiomyosarcoma with about 1/3 of all patients, 31.7 % (n=19). Median tumor size was 20 (range, 3 - 60) cm. Multivisceral resection was performed in 33 cases (55 %). An R0 resection status was achieved in 24 cases (40 %). The kidney (n=18, 30 %) followed by the psoas muscle (n=11, 18.3 %) were most frequently resected in addition to the primary tumor lesion representing multivisceral surgical approach. The median surgery time was 180 minutes (range, 30-535) minutes, the median intraoperative blood loss was 400 (range; 0-9500) ml, regardless of the extent of the resection with both parameters. Additional surgical
procedures were performed in 14 cases (23.3 %). Furthermore, 47 patients (78.3 %) needed intensive care postoperatively with a median stay of 3 days at the intensive care unit. The majority of the patients with primary RPS (n=37, 61.6 %) had an unremarkable postoperative course. Despite the severity of the interventions, only 11 (18.3 %) of the patients had major complications (grade III - V according to Clavien-Dindo classification). Of the 11 patients with major complications, 9 had a multivisceral resection; however, there was no significant difference (p = 0.08). The 30-day and 90-day mortality was 1.7 % (n=1) and 5.6 % (n=3), respectively. The median survival was 64 + SF 9.8 months. There was a longer median survival in patients with a multivisceral sarcoma resection 67 + SF 13.7 (range, 4-221) months compared to patients after sarcoma resection alone 63 + SF 20.4 (range, 1-286) months. However, there is no significant survival benefit for either of the two types of surgery (p = 0.92). Corresponding 5- and 10-year overall survival was 43.3 % (n=26) and 21.6 % (n=13) - further data evaluation with regard to significantly influencing factors and parameters as well as multimodal therapeutic measures in the pre- and postoperative setting is ongoing.

Conclusion:
The study results show that even before the paradigm shift in the late 2000s, multivisceral sarcoma resections were regularly performed in our institutions in patients with primary RPS with comparable postoperative complication rates and R0 resections.
NurMut! Digital - Online-based surgical hands-on training
ID: 91

Peter Wilhelm*1, Johanna Miller1, Kai Jansen1, Natalia Kandinskaja2, Benedikt Braun3, Andreas Kirschniak1, Jens Rolinger1
1Kliniken Mariahilf GmbH Mönchengladbach, Klinik für Allgemein- und Viszeralchirurgie, Mönchengladbach, Deutschland, 2Berufsverband der Deutschen Chirurgen e.V., Berlin, Deutschland, 3BG Klinik Tübingen, Klinik für Unfall- und Wiederherstellungschirurgie, Tübingen, Deutschland

Background:
From a medical perspective, the COVID-19 pandemic not only places a heavy burden on healthcare systems around the world, but also has a significant impact on the training of undergraduate students and junior doctors. Under the given circumstances, medical faculties and training course providers are forced to transfer the previously face-to-face teaching into virtual formats. This is particularly difficult with regard to the teaching of clinical practical skills, with the surgical disciplines being the most affected. It is therefore essential to further develop and report digital concepts for practical skills training in order to maintain high-quality teaching. With the young talent campaign "Nur Mut! Digital – Chirurgie zum Mitmachen", a new virtual format with a "hands-on" character has been developed under the sponsoring of the "Berufsverband der Deutschen Chirurgen" (BDC).

Materials and methods:
The course was designed to provide hands-on instruction in the following basic surgical skills: 1) osteosynthesis 2) conventional knot-tying and suturing and 3) laparoscopic knot-tying and suturing. Two main problems arose with regard to the practical implementation of such an initiative. First, the selection of a suitable platform for exchange between students and instructors and second, the provision as well as allocation of the necessary learning materials. A numerical, six-point Likert-type response scale (1 = "strongly agree", 6 = "strongly disagree") was used to record the students' subjective evaluation of the training.

Results:
A 60-minute session was thus planned for each of the three major topics, consisting of a brief theoretical introduction followed by a practice phase. The Zoom video telephony software from Zoom Video Communications Incorporation (San Jose, California, USA) served as the communication platform, so that participants could follow the session in teams of two from home. In terms of the necessary materials, a mobile toolbox was assembled. The core elements of each box consisted of a specially developed mobile laparoscopy as well as osteosynthesis trainer. In addition, the toolbox contained the appropriate surgical instruments as well as materials required. The toolbox was sent to the participants by mail in accordance with hygiene regulations and its contents were disinfected after each use. To date, two courses have been successfully conducted with a total of 41 participants. 17 of the 20 teams (85%) subsequently answered the online evaluation. Among other things, the statement "I would recommend the course to others" was given an average rating of 1.29.

Conclusion:
Under the given circumstances, the strengthening of digital teaching offerings was and is unavoidable due to the necessary contact restrictions and hygiene measures. However, this also offers the opportunity to further develop proven teaching formats. The goal here should not be to displace established face-to-face courses. Rather, existing teaching concepts can be enhanced in a meaningful way by exploiting their advantages. Virtual concepts such as "Nur Mut! Digital – Chirurgie zum Mitmachen" can contribute to this and, in the best case, serve as an impulse for curricular programs.
Heicovid - Heidelberger digital student´s education during corona pandemia

ID: 243

Fee Klupp*, Stefan Mohr², André Mihaljevic³
¹ Universitätsklinikum Heidelberg, Klinik für Allgemein, Viszeral- und Transplantationschirurgie, Heidelberg, Deutschland, ²Universitätsklinikum Heidelberg, Klinik für Anästhesiologie, Heidelberg, Deutschland, ³Universitätsklinikum Ulm, Klinik für Allgemein - und Viszeralchirurgie, Ulm, Deutschland

Background:
Both, Surgery and Anesthesiology are nearly solely practical disciplines and student’s education is based mainly on practical skills like eg. bed side teaching, surgical suture exercise, visitation in the operation room or resuscitation course. During Corona pandemia all these practical courses were skipped from one day to another and the urgent need of a compensational teaching program was given.

Materials and methods:
All practical student courses of the department of surgery and anesthesiology were stopped and adjusted accordingly the corona pandemia statutory guidelines for student’s teaching (HEICOVID). Resulting in a semester with online teaching, exclusively with the possibility of flexible switching depending on current corona guidelines. A video-conference software (HEICONF) from the university of Heidelberg was used to establish and perform digital lessons.

Results:
Acceptance under the students of digital teaching was very strong with high attendances during digital lessons although being voluntary without any obligatory courses. Changing of primary practical disciplines in a solely digital setting is very suitable for tutorials and lectures, but also practical skills like surgical nodes courses or bed side teaching with actors online were implementable.

Conclusion:
Digital student’s lessons during Covid pandemia reveal a good compensation even in highly practical disciplines. Nevertheless, missing contact to real patients cannot be counterbalanced adequately.
New approaches in laparoscopic simulation training: Play hard, work hard!
ID: 700

Nora Weisser¹, Andreas Lindner*¹, Martina Heinrich¹, Petra Zimmermann², Julia Küppers¹, Oliver Muensterer¹
¹LMU Klinikum München, Kinderchirurgische Klinik und Poliklinik, München, Deutschland, ²LMU Klinikum München, Klinik für Allgemein-, Viszeral- und Transplantationschirurgie, München, Deutschland

Background:
While practical education in laparoscopic surgery focuses mostly on high-fidelity models and circumstances, simply having fun during training may increase compliance. During a validation study for a new pediatric surgery training platform, we observed that laparoscopic performance improved correspondingly if the students were given the opportunity to complete “fun games” instead of rigid exercise program.

Materials and methods:
We designed a curriculum containing six training modules: camera guide, shell transfer, gauze cutting, cyst resection, single interrupted suturing, and slipknot suturing. Instructions explaining the requirements to complete an exercise were given by video tutorial.
The study population of medical students, pediatric surgery trainees and specialists was divided in 3 groups. Group 1 consisting of 25 medical students and 11 pediatric surgery trainees, group 2 of 8 pediatric surgery specialists and group 3 of 10 medical students.
Group 1 and 2 performed the entire curriculum on three different days. Group 3 played laparoscopic “Memory”, “Chess”, “Checkers”, “Ludo” or threaded a “friendship bracelet” for 1 hour instead of the laparoscopic curriculum on the first day. On the following two days, they performed the curriculum. We categorized students and pediatric surgery trainees as “novices” and pediatric surgery specialists as “experts”.
We compared the results of the first day of group 1 and group 2 for skill evaluation. And the last day of group 1 (only the students) and group 3 for learning curve. Statistical analysis was conducted with the Welch’s T-test.

Results:
The validation study showed that there was a significant difference between novices and experts in the time needed for each module. To complete the “slipknot suturing” task, group 1 needed 448s ± 219 (n=36) versus 250s ± 99 for group 2 (n=8, 95%CI: -104.31 - 0.04s); p<0.001).
Group 1 made 0.19 ± 0.47 (n=36) mistakes, group 2 0 ± 0 (n=8, 95%CI: -0.16 - 0.03); p<0.021).
For better comparability, we chose only the students of group 1 and matched them with group 3. For “slipknot suturing”, there was no significant difference: Group 1 students needed 296s ±105 (n=25) versus 341s ±46 for group 3(n=10) (D= -44.7s (95%CI: -52.00 - 0.03s); p>0.087, effect size 0.49, post-hoc power 42.1%).
Group 1 students made 0.08 ± 0.28 (n=25) mistakes, versus 0.2 ± 0.42 in group 3 (n=10). (D= -0.12 (95%CI: -0.31 – 0.10); p>0.42, effect size 0.37, post-hoc power 13%).

Conclusion:
The validation study showed that the time needed to finish the modules was a good predictor for the practical skills of a surgeon. The final results of students who completed the entire laparoscopic simulation curriculum each time (group 1) compared with students who played “fun games” on the first day of practice and the curriculum the following two days (group 3) showed no statistical significance.
While realistic models may have their role in education and practical training, playing laparoscopic games may convey similar skills without adhering to a rigid training curriculum.
Digital teaching of surgical skills: A best practice example of a blended learning concept combining the flipped classroom approach and video-based self-control strategies

ID: 1053

Mohamad Hashem*, Ana Lucia Paz Hernandez¹, Sadaf Khalatbarizamanpoor¹, Carina Bachmann¹, Uta Dahmen¹
¹Universitätsklinikum Jena, Department of General, Visceral and Vascular Surgery, Jena, Deutschland

Background:
Acquisition of surgical skills was recently transferred from the operating room to the protected environment of skills labs. Therefore, we established a class for basic surgical techniques consisting of (I) a theoretical part covering the contextual facts and (II) a series of consecutive exercises ranging from surgical knots to advanced suture techniques (4h/day for 5 days). Fostered by the COVID-19 pandemic, digital teaching became mandatory. Transferring the acquisition of declarative knowledge into a digital format was achieved by replacing on-site lectures with live or prerecorded online-presentations. However, fostering the acquisition of practical skills and competences over distance represented a true challenge.

We took this challenge by transferring our well-established onsite class for surgical techniques into a completely digital format. Therefore, we created a novel blended learning-concept combining the flipped classroom-approach with our well-established video-based self-control strategies.

Materials and methods:
First, we identified the prerequisites for distant teaching of declarative knowledge and of supervision of practical exercises: (a) availability of all theoretical content in a learning management system, (b) availability of all needed materials for the students in their homes; (c) possibility of simultaneous video recording and streaming of student exercises, (d) possibility of supervised interactive analysis of student performance.

Second, we applied the technical and didactic concept in 3 cohorts of totally 44 students. We assessed the acceptance of this course format by asking for a structured anonymous written feedback and an open oral discussion.

Results:
Technical solutions: (a) We uploaded all materials (powerpoint presentations, video-clips of exercises and error-videos into the LMS (moodle). (b) We composed a “surgical-training-kit” consisting of all materials needed including two pig feet, instruments, suture materials and a script, to be picked up by the students prior to the class. (c) We achieved simultaneous video streaming and recording by making the student to log into a video conference tool (Zoom) with two devices: a mobile phone for streaming and a laptop for screen recording of the pinned handy video and for direct communication with the students. The students had to upload the screen recorded video into OpenCast. (d) We enabled the supervised interactive analysis by encouraging the students to annotate at home one video per exercise in writing using Open cast studio. Arbitrarily selected videos and annotations were discussed in the next class in the plenary session as a feedback for the students.

Practical implementation and evaluation: Before the class, the students got access to the LMS for reading through the material, checking their knowledge by answering multiple choice and free text questions and performing the video-analysis exercises. At the same time, the students were invited to pick up the “surgical-training-kit”. We scheduled an online introduction seminar prior to the class to explain the technical setup using the kit and to confirm that everybody could log in with the two devices.

Each day started with a plenary session explaining the learning goals of the day followed by a life-demo of the given exercise. For better direct supervision, 3-5 students were assembled in a break out room to be supported by their tutor. This was facilitated by a technical coordinator making sure that all small groups were synchronized in their timing. The students videotaped all exercises using the screen
recording function of the laptop and uploaded them in Opencast studio to make them accessible for the whole group to enable reciprocal annotation and the corresponding feedback. Using this peer teaching approach, all students could judge the performance of a colleague and give feedback on the comments they received.

We obtained feedback from 3 cohorts of totally 44 students and from all tutors. All students appreciated the possibility to be offered a practical training despite the restriction for on-site classes, but even more the high efficiency of this training program. All tutors perceived the necessity for almost exclusively verbal corrections as a great challenge. However, the possibility of simultaneous observation of a small number of students facilitated to interfere when noticing a deviation from the predefined action possibly resulting in an error.

**Conclusion:**

We successfully transferred an on-site class for acquiring basic surgical skills into a digital format. Based on our initial positive experience, we conclude to maintain a hybrid format. We will combine on-site classes with our online streaming technology enabling the simultaneous supervision of small groups of students. However, we will improve the training of our tutors to enhance their ability to verbally explain potential risks of errors.