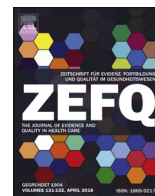




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Qualität und Sicherheit in der Gesundheitsversorgung / Quality and Safety in Health Care

## Elective surgery in times of COVID-19: A two-centre analysis of postponed operations and disease-related morbidity and mortality



### *Elektive Operationen in Zeiten von COVID-19 – bizen trische Analyse der verschobenen Operationen und der krankheitsbezogenen Morbidität und Mortalität*

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## ABSTRACT

**Introduction:** COVID-19 had an impact on the whole range of worldwide medical services. Due to the high risk of in-hospital transmission and disproportionate perioperative rates of morbidity and mortality in occult COVID-19 patients surgeons were faced with the challenging triage of surgeries into emergency, urgent and elective. The present study investigates postponed elective surgery and its impact on the medical condition of patients in two high-volume departments of general, visceral, thoracic, transplant and vascular surgery.

**Methods:** Operations that have been postponed due to COVID-19 were recorded in the Departments of General-, Visceral-, Thoracic- and Vascular Surgery at the University Hospitals of Leipzig and Greifswald. Data was analysed descriptively concerning patient outcomes as well as emergency admissions and surgeries.

**Results:** In the Leipzig and Greifswald University Hospitals 89 and 92 elective surgeries were postponed, respectively. No patient needed an extension of surgical procedure when eventually operated. One patient with extensive obesity died early during the suspension period due to cardiac complications. Four patients needed emergency admission to hospital one of whom required urgent surgery. In neither of the two surgical departments did a patient acquire a nosocomial infection with COVID-19.

**Discussion:** While medical consequences of COVID-19 seem multidimensional and severe, our data indicate that the short-term postponement of elective surgery did not cause an unproportional increase of morbidity and mortality. Although the restrictions may have been fear-driven, given no confirmed cases and thus no concrete risk of infection, the early and well-coordinated action may have provided protection from uncontrolled interruption of medical services by loss of medical workforce or capacity.

**Conclusion:** Well-organized and early suspension of elective surgery had no disproportionate impact on patient outcomes while averting nosocomial transmission of COVID-19.

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## ZUSAMMENFASSUNG

**Hintergrund:** COVID-19 beeinflusste die weltweite medizinische Versorgung. Das hohe Risiko für nosokomiale Infektionen mit COVID-19 und das unverhältnismäßig hohe perioperative Morbiditäts- und Mortalitätsrisiko asymptomatischer COVID-19-Patienten konfrontierte Chirurginnen und Chirurgen mit der Notwendigkeit zur Kategorisierung in Notfallmäßige, dringliche und elektive Operationen. Die vorliegende Studie analysiert die während COVID-19 verschobenen elektiven Operationen und den medizinischen Outcome in zwei deutschen Universitätskliniken für Allgemein-, Viszeral-, Thorax-, Transplant- und Gefäßchirurgie.

**Methode:** Die während COVID-19 in den Kliniken für Allgemein-, Viszeral-, Thorax-, Transplant- und Gefäßchirurgie Leipzig und Greifswald verschobenen elektiven Operationen wurden erfasst und hinsichtlich des medizinischen Outcomes sowie Notfallmäßigen Krankenhausaufnahmen und Operationen deskriptiv analysiert.

**Ergebnisse:** Jeweils 89 bzw. 92 elektive Operationen wurden in der Leipziger und Greifswalder Klinik verschoben. Bei keinem Patienten musste bei der letzten Operation das Operations- bzw. Resektionsausmaß erweitert werden. Eine Patientin mit morbiditer Adipositas verstarb frühzeitig während der Aussetzungsfrist an kardialen Komplikationen. Vier PatientInnen mussten Notfallmäßig stationär aufgenommen werden, von denen eine dringlich operiert werden musste. In keiner der untersuchten Kliniken kam es zu einer nosokomialen Infektion mit COVID-19.

**Diskussion:** Wenngleich COVID-19 zu schweren und multidimensionalen medizinischen Konsequenzen führt, deuten unsere Daten darauf hin, dass das kurzfristige Aussetzen elektiver Operationen keinen unverhältnismäßigen Einfluss auf die Morbidität und Mortalität der PatientInnen hatte. Obwohl die Einschränkungen vor dem Hintergrund der niedrigen lokalen Infektionsraten möglicherweise angstgetrieben erscheinen mögen, verhinderte die frühzeitige und gut strukturierte Verschiebung der Operationen ein unkontrolliertes Aussetzen medizinischer Kapazitäten.

**Schlussfolgerung:** Die gut strukturierte und frühzeitige Verschiebung elektiver Operationen hatte keinen unverhältnismäßigen Einfluss auf das patientenbezogene outcome und schränkte gleichzeitig die nosokomiale Ausbreitung von COVID-19 ein.

## Introduction

COVID-19 pushed global health care to new boundaries and had impact on the whole range of worldwide medical services. In January 2020, WHO declared the spread of novel coronavirus 2019-nCoV a Public Health Emergency of International Concern (PHEIC) [1]. This declaration highlighted the immediacy and security concerns of the pandemic and shed light on the responsibility of health care systems to be prepared for a great number of patients requiring intensive care and ventilation. Bearing in mind disproportionate perioperative rates of morbidity and mortality in occult COVID-19 patients [2–4] and the duty of care for non-infected patients as well as healthcare workers, elective surgery was interrupted in Germany by decision of the federal and state authorities. Surgeons were confronted with the challenging triage of patients and categorization of surgeries into emergency, urgent and elective. However, it is obvious that elective does not mean non-essential surgery. Postponing surgeries bears the risk of disease progression and loss of quality of life. With a flattening of infection curve, planning of elective surgery became possible again after three months simultaneously allowing to evaluate the consequences of deferral. The present study investigates postponed elective surgery and impact on medical condition of patients in two high-volume departments of general, visceral, thoracic, and vascular surgery.

## Methods

Postponed operations due to COVID-19 were recorded in Departments of General-, Visceral-, Thoracic- and Vascular Surgery at University Hospitals Leipzig and Greifswald having 95 and 54 hospital beds, respectively. Due to resource allocation for expected COVID-19 patients, number of hospital beds were reduced from 54 to 42 in the investigated department in Greifswald. Elective surgery was completely suspended from March 16<sup>th</sup> to April 20<sup>th</sup>, 2020. Thereafter elective OR capacities were gradually increased. In Leipzig, cancelled operations were recorded by central patient management and date of cancellation, information of patient as

Table 1

Surgical conditions that were treated during COVID-19 restrictions.

All emergency operations
Malignant diseases
Highly suspect tumors
Hyperthyroidism refractory to conservative treatment or trachea compressing struma
Hyperparathyroidism with highly elevated calcium levels
Hormone-active adrenal and pancreatic tumors including pheochromocytoma
Organ transplant and explant
Aortic aneurysm repair in extensive aneurysms with immediate risk of rupture
Carotide endarterectomy
Revascularization and limb amputation
Tracheostomy

well as definite date of operation were documented in hospital's documentation system. Possible additional information from the patients, for example self-initiated postponement or cancellation was documented as well. In Greifswald, coordination of postponement was done via surgical wards that recorded each patient. That ensured that all suspended surgeries were traced back. Eventual operations were screened for possible extension of surgery, defined as substantial expansion of resection, for example amputation in case of PAOD, or deviation from initially planned surgery, for example colostomy.

## Elective Surgery

Decision for postponement of operations was made along recommendation of German Society of Surgery. Surgeries that were performed at all times are summarized in Table 1. All other surgical conditions were suspended. Resumption of elective surgery was as well prioritized according recommendation of German Society of Surgery, starting with benign diseases with potentially life-threatening progression, no option for conservative treatment and high risk for flare-ups. Stable diseases with low impact on life quality were scheduled latest.

**Table 2**  
Number of postponed operations and average postponement in days.

	Leipzig hospital			Greifswald hospital			N total
	N total	Percentage	Average postponement in days	N total	Percentage	Average postponement in days	
Visceral Surgery	<b>55</b>	<b>61,8</b>		<b>54</b>	<b>58,7</b>		<b>109</b>
- Oesophagus	5	5,6	103	3	3,3	90	8
- Intestine	14	15,7	90	6	6,5	75	20
- Gall bladder	6	6,7	73	5	5,4	82	11
- Liver	3	3,4	47	0	0	-	3
- Thyroid/Parathyroid	14	15,7	72	20	21,7	82	34
- Hernia	4	4,5	89	15	16,3	110	19
- Proctology	5	5,6	124	2	2,2	90	7
- other	4	4,5	58	3	3,3	72	7
Bariatric surgery	<b>17</b>	<b>19,1</b>	<b>67</b>	<b>9</b>	<b>9,8</b>	<b>98</b>	<b>26</b>
Vascular Surgery	<b>13</b>	<b>14,6</b>		<b>29</b>	<b>31,5</b>		<b>42</b>
- Varicosis and Paod	7	7,9	65	17	18,5	47	24
- Aortic/Pelvic Aneurysma	2	2,2	50	2	2,2	62	4
- Revascularization/other	4	4,5	81	10	10,9	74	14
Transplant (living donation)	<b>3</b>	<b>3,4</b>	<b>97</b>	<b>0</b>	<b>0</b>	-	<b>3</b>
Thoracic	<b>1</b>	<b>1,1</b>	<b>54</b>	<b>0</b>	<b>0</b>	-	<b>1</b>

## Results

### Leipzig University Hospital

217 operations were performed during the observation period from March 16<sup>th</sup> to April 20<sup>th</sup>. In contrast to that, 340 surgeries were conducted during the same period in 2019. Average bed occupancy declined from 75 to 60 per cent. 89 elective operations were postponed during COVID-19 restrictions. One female patient that was planned for laparoscopic gastric sleeve resection to treat extensive obesity (BMI > 90 kg/m<sup>2</sup>) died early during suspension period due to cardiac complications. One male patient went to another hospital for cholecystectomy. One patient suffering from conn-syndrome was initially rescheduled and had to get operated urgently after emergency admission because of severe hypokalaemia. Three patients were admitted to hospital in the meantime but were successfully treated without the need for urgent surgery (sigmoid diverticulitis, biliary pancreatitis, and wound deterioration in peripheral arterial occlusive disease, PAOD). No patient needed extension of surgical procedure when eventually operated. Most patients postponed waited for bariatric surgery (N = 17), followed by surgery on thyroid and parathyroid (N = 14) and intestine (N = 14). Differentiated for subdisciplines most operations had to be deferred in visceral surgery (N = 72) and least in thoracic surgery (N = 1, endoscopic thoracic sympathectomy). Three patients have not been operated yet due to personal schedule. The specified average values of the postponed days relate to the operations that have actually been carried out so far. Average time of postponement differed from 47 to 124 days. [Table 2](#) shows postponed surgeries classified for operated organ as well as average time of suspension.

### Greifswald University Hospital

181 operations were performed during the observation period from March 16<sup>th</sup> to April 20<sup>th</sup>. In contrast to that, 272 surgeries were conducted during the same period in 2019. Average bed occupancy declined from 90 to 75 per cent although total number of beds was reduced as described above. 92 elective operations were postponed during COVID-19 restrictions. No patient died or needed extended surgery after deferral. However, three patients with PAOD showed wound deterioration and needed earlier surgery. They were admitted to the emergency room and operated no later than three days after admission without need for extension of initially planned surgical procedure. Most patients postponed waited for thyroid- or parathyroidectomy (N = 20), followed by surgery on varicosis or

PAOD (N = 17) and hernia (N = 15). In Greifswald, varicose vein operations are still postponed because the patients do not want to have the operation performed in summer but prefer to have it done in autumn. The same is true for 2 benign oesophagus, 2 bariatric and 3 thyroid operations. In addition, one aneurysm operation has not yet been carried out because the patient does not want the operation until autumn and the aneurysm is stable and not at immediate risk of rupture. The specified average values of the postponed days relate to the operations that have actually been carried out so far.

## Discussion

Cancellation and postponement of operations were undertaken in risk assessment of unbearable perioperative complications in case of infection with 2019-nCoV. While global burden of COVID-19 was unprecedented in terms of infection and mortality rates, regional prevalence differed largely. Both investigated surgical departments recorded no confirmed case of COVID-19 with Greifswald University Hospital recorded no confirmed case at all. This fact underlines the brought impact epidemics of infectious diseases bear for the provision of surgical care. More and more frequently, infectious diseases become a matter of security [5–7]. In case of COVID-19, the declaration of PHEIC marked the diseases as a massive international security risk. The increasing securitization of infectious diseases puts surgery at risk to fall behind [8]. Previous epidemics have shown how uncoordinated suspension of medical services in times of epidemics impaired essential surgical supply: during the outbreak of Ebola in Western Africa in 2014, numbers of surgery declined dramatically to 50 to 3 per cent in Sierra Leone [9,10]. High rates of in-hospital transmission with a disproportionate mortality of health care workers [11] also restricted surgical education programs with important international programs being paused [12]. Sell et al. see the risk for impaired surgical education with long-time consequences for the surgical workforce as well in the realm of COVID-19 [13]. Fu et al. summarized the multidimensional indirect consequences of COVID-19 on surgery including a relevant backlog of elective operations, disease progression in consequences of delayed care, impaired surgical educations due to cancelled scholarships and lectures as well as economic losses from postponed surgery [14]. Globally, more than 28 million operations were estimated to be cancelled or postponed during the 3 month enduring peak of COVID-19 requiring 45 weeks to compensate the loss provided that post-pandemic surgical rate was increased by 20 per cent [15]. Other data indicate a decrease of emergency cases that is not fully understood [16]. The outcome of these

patients may have been worsened by the securitized realm of the pandemic.

Restart of elective surgery was organized according to the urgency for operative treatment and in line with the recommendation of German Society of Surgery, starting with benign diseases with potentially life- or limb-threatening progression like aortic aneurysm, PAOD stadium III, no option for conservative treatment and high risk for flare-ups like endocrine surgery, symptomatic liver tumors or hernia with risk for incarceration. Stable diseases with low impact or life quality were scheduled latest.

Low number of postponed hernia surgery is striking, however reasons for that seem multifaceted. On the one hand, less patients were seen and planned for surgery due to early closing of out-patient clinic. On the other hand, a significant number of hernia operations is conducted as out-patient surgery [17]. In the special case of Leipzig University Clinic, surgical treatment of hernia is organized through a cooperation agreement with a municipal hospital explaining the already small number of hernia surgery in normal times. In Greifswald, most hernia operations are carried out by Practicing Surgeons while only major or complex hernia operations or patients with severe comorbidities are treated at University Clinic.

While indirect financial and educational consequences of COVID-19 seem multidimensional and severe, our data indicate that the short-term postponement of elective surgery did not cause an unproportional increase of morbidity and mortality. Although the restrictions may be fear-driven given no confirmed cases and thus no concrete risk of infection, the early and well-coordinated action may have protected from uncontrolled interruption of medical services by loss of medical workforce or capacity. Moreover, early suspension of elective medical treatments unleashed capacity for routine SARS Cov-2 testing and logistics for potentially infected patients. By that, no case of nosocomial infection with COVID-19 happened in the investigated surgical clinics. This additionally prevented from prognosis-worsening postponement of surgical therapy due to COVID-19.

Our study has several limitations. Our results can only be applied in settings where infection rates remained low and time of surgical delay was short. Low infection rates ensured reliable capacities of ventilation and intensive care unit. This enabled the investigated departments to perform cancer surgery at every time of the epidemic. This was consistent with the recommendation of the German Society of Surgery. However, this may be different from the management of other hospitals. Hence, our data analysis cannot make statements for the postponement of malignant diseases. Moreover, the reduction of out-patient clinics may have had a substantial impact on patients treated and postponed that is not included in our data. Additionally, some patients might have been treated in other hospitals that did not suspend elective surgery from early on.

## Conclusion

Well-organized and early suspension of elective surgery prevented from nosocomial transmission of COVID-19 and had no disproportionate impact on patient's disease-related morbidity and mortality

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## Conflict of interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

## CRediT author statement

Isabella Metelmann: Conceptualization, Methodology, Validation, Formal analysis, Investigation, Writing – Original Draft. Alexandra Busemann: Conceptualization, Methodology, Validation, Formal analysis, Investigation, Writing – Review & Editing.

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