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TOPIC PAPER

Surgical safety in radical cystectomy: the anesthetist's point of view—how to make a safe procedure safer

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Abstract

Purpose The aim of this review is to present an anesthesiological overview on surgical safety for radical cystectomy implementing the cornerstones of today's rapidly evolving field of perioperative medicine.

Methods This is a narrative review of current perioperative medicine and surgical safety concepts for major surgery in general with special focus on radical cystectomy.

Results The tendency for perioperative care and surgical safety is to consider it a continuous proactive pathway rather than a single surgical intervention. It starts at indication for surgery and lasts until full functional recovery. Preoperative optimization leads to superior outcome by mobilizing and/or increasing physiological reserve. Multidisciplinary teamwork involving all the relevant parties from the beginning of the pathway is crucial for outcome rather than an isolated specialist approach. This fact has gained importance in times of an ageing frail population and rising health care cost. We also present our 2019 Cystectomy Enhanced Recovery Approach for optimization of perioperative care for open radical cystectomy in a high caseload center.

Conclusions With the implementation of in itself simple but crucial steps in perioperative medicine such as multimodal prehabilitation, safety checks, better perioperative monitoring and enhanced recovery concepts, even complex surgical procedures such as radical cystectomy can be performed safer. Emphasis has to be laid on a more global view of the patients' path through the perioperative process than on the surgical procedure alone.

Keywords Perioperative medicine · Patient safety · Radical cystectomy

Introduction

In recent years, attention on perioperative medicine has increased considerably [1]. By definition, it is a proactive multidisciplinary effort and shared decision-making process involving anesthetists, surgeons, nurses and physiotherapists. It starts from the moment of contemplation of surgery and lasts until full recovery [2–4]. The aim of perioperative medicine is to deliver the best possible pre-, intra- and postoperative care to meet the needs of patients undergoing major surgery [1]. Perioperative care pathways to optimize patient experience of care, safety and outcome have gained acceptance [3]. In times of increasingly complex medical needs, an ageing population with a substantial amount of comorbidities and the economic pressure in health care, it is of crucial importance to pay close attention to every single step of patient care for surgery.

Radical cystectomy (RC) is a highly complex major abdominal surgery and a multidisciplinary approach is paramount to achieving optimal outcomes [5]. A cornerstone in the practice of anesthesia is the goal to improve patient safety and reduce avoidable harm. However, while harm directly attributable to the conduct of anesthesia has become rare (< 1 in 50,000 mortality), there is arguably an epidemic of avoidable harm after major surgery with dramatic variation in patient outcomes between institutions and nations [1]. In this review, we give an overview on general principles of optimal perioperative care followed by implications for the setting of radical cystectomy and on how to make this safe procedure safer.

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Perioperative medicine as a continuous pathway

Ideally, perioperative care would be organized as a standardized pathway starting in the outpatient clinic when indication for surgery is made until the patient returns to his full functional recovery at home [6]. There are many obstacles and challenges for reaching this integrative approach to delivering care for "a single operation", and it is key that care providers focus on the bigger picture and not only on the surgical procedure alone. For this, it is crucial that the surgeons and anesthetists consider themselves as one perioperative team rather than isolated specialties (Fig. 1) [7].

Bundled care

The concept of “bundled care” has been big news in the last few years [8]. This is an episode-based payment where hospitals are reimbursed for the expected costs for a defined episode. At the same time the hospitals are accountable for all costs of care for 90 days after the index surgery, whether or not related to the original episode. The first major widespread program in the USA has shown a reduction of cost, decreased length of stay, better mobility, more patients going directly home, and decreased re-admissions at 90 days for patients who had a bundled care compared with those who did not [9]. In some ways, this has been an accelerated lesson in perioperative medicine to understand the complications and problems that arise in the extended perioperative period. This approach has also been successfully used in The Netherlands and Sweden, where it leads to a 33% reduction in complications after surgery and a 17% reduction in cost [8].

Until not too long ago, the surgeons and anesthetists in charge did not see the patients until their admission the night before surgery. Operations in high-risk or elderly patients were cancelled on the day of surgery due to lack of fitness or preparation; many others proceeded without adequate risk assessment, discussion or modification [6]. Many patients suffer complications including death following surgery. These adverse events have occurred due to lack of time or care, insufficient communication, lack of adherence to simple checklists or guidelines, frustrating teamwork or missing optimal preoperative assessments. Although great progress has been made in surgical techniques, anesthesia, analgesia and perioperative care, complication rates after major surgery remain above 30% [10, 11]. Many of the above-mentioned complications could be avoided or reduced by the concept of perioperative medicine where all these specialties and steps are considered to be one process as a whole rather than separated single steps (Fig. 1).

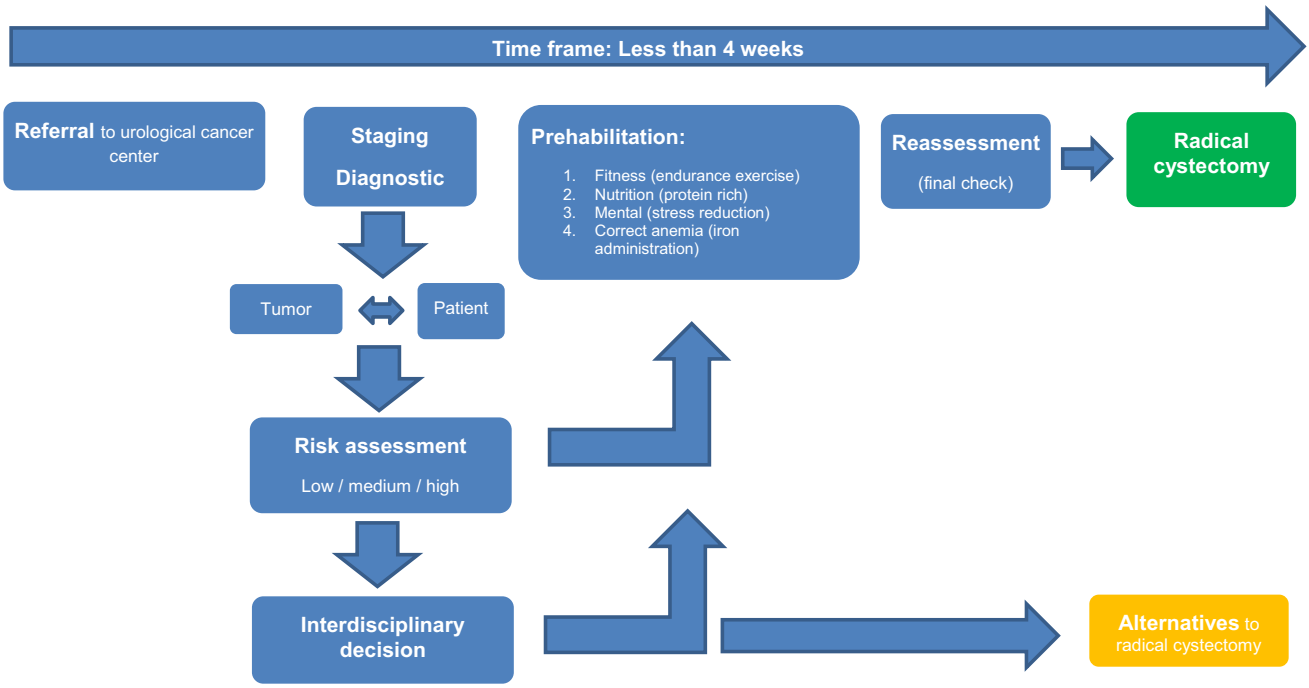


Fig. 1 The modern perioperative pathway

Preoperative optimization

Assessment and investigation

The goal of preoperative assessment (POA) is to facilitate risk assessment of the individual surgical patient through targeted investigations leading to appropriate decision-making and allocation of perioperative resources to benefit recovery from surgery and long-term outcome.

The surgery specific risk for any given patient will rise with increasing surgical complexity. Mortality rates for different surgeries vary. The level of investigation should reflect this. The National Institute of Health and Care (NICE) has developed a surgical grading system [12]. In this system, radical cystectomy is a graded "major or complex surgery" (surgery severity 4 on a scale 1–4), and the risk for perioperative complications is high. Patient-specific risk consists of the severity of individual chronic medical conditions and is important to POA. The American Society of Anesthesiologists (ASA) classification provides a grading system to give an immediate assessment of a patient's clinical state.

Overall complication rate for elective non-cardiac surgery is 7–11% with a combined mortality of 0.8–1.5%, whereof 42% arise from a cardiovascular cause [13]. Renal failure is identified as an independent risk factor for morbidity and mortality perioperatively [14]. Patients with preexisting pulmonary disease such as chronic obstructive pulmonary (COPD) disease are at high risk for postoperative pulmonary complications [15]. Further, uncontrolled diabetes mellitus can cause life-threatening conditions such as electrolyte imbalances, dehydration and wound infection [16].

Comprehensive history and physical examination remain the most basic tools, yet they are the initial steps to preoperative evaluation and are decisive for the thoroughness of further preoperative investigations. For cardiovascular assessment and management, the European Societies of Cardiology (ESC) and Anaesthesiology (ESA) have published guidelines on risk assessment-based cardiac evaluation preoperatively [17]. To guide preoperative testing, the NICE has reviewed the use of routine tests for elective surgery considering ASA status and surgery specific risk, and published a practice guideline [18].

To involve the anesthetists as early as possible after surgical indication leads to target-oriented laboratory and functional testing prior to surgery according to these recommendations. It is important to focus investigative resources wherever preoperative intervention and subsequent optimization will direct and/or improve management and outcome without delaying surgery in case of oncological cases.

Patient optimization before surgery: multimodal prehabilitation

There has been a growing realization that successful surgery is not dependent solely on the operation but rather on how well the patient is able to return to a physically and psychologically healthy state. Later, evidence emerged that poor physical fitness was associated with adverse outcomes following surgery [19]. At 3 months after major elective surgery, up to 50% of patients still demonstrate any degree of disability [20]. When the impact of abdominal surgery is evaluated using measures of functional capacity, only 30% of patients had recovered to preoperative levels at 8 weeks and 50% at 6 months after surgery [20, 21]. Perioperative medicine has built on this and is now understood to encompass the patient-centered, multidisciplinary and integrated medical care of patients for the pre- to the postoperative care, until full recovery [22].

Preoperative modification of the high-risk patient includes both lifestyle and medical optimization of comorbidities. The term prehabilitation has emerged to describe the identification of impairments and then provide interventions that promote physical (with endurance and resistance exercises), metabolic (nutritional supplements) and psychological health (stress reduction) to reduce the incidence and/or severity of these impairments [23]. Several original studies and systematic reviews show a positive impact of prehabilitation on physical function, quality of life, postoperative complications and length of hospital stay [24–27]. There is evidence suggesting these findings are also observed in patients undergoing radical cystectomy [28].

Old, older, your patient: the elderly are not simply old adults

The annual percentage of surgical interventions in the last 30 years has almost doubled for men and women aged 75–84 years. In addition, the elderly undergo surgery four times more often than the rest of the population, thus in the near future a major proportion of patients presenting for surgery will be aged older than 65 years, with a substantial number older than 85 years [29]. Elderly patients tend to have more postoperative complications and a longer convalescence; surgical morbidity and mortality increase and rise sharply after the age of 75 due to reduced functional reserve (frailty) [30].

However, is there an age limit to label a patient as "too old for surgery"? The severity of preoperative comorbidities is a far more important predictor of postoperative adverse outcomes than chronological age [31]. Hence, biological age which is the result of pathophysiologic ageing processes, comorbidity and genetic factors, seems to be a better predictor of the degree of fitness and performance of a person

during illness (comprehensive geriatric assessment) [32]. Frailty significantly increases the risk of postoperative complications, prolonged hospital stay and institutionalization in older patients. Frailty also improves the predictive power of the ASA score. In frail RC patients, the 30-day mortality and incidence of Clavien–Dindo grade IV complications increased by a third compared to non-frail patients [33]. Therefore, we do not have a chronological but rather a biological age limit for radical cystectomy.

When planning elective surgery in elderly patients, the decision should take into account their risk of postoperative cognitive dysfunction and the impact it may have on their quality of life [34]. Postoperative delirium is associated with greater cost, longer length of stay, complications, poor recovery, institutionalization, and mortality [35]. It has been shown to be preventable in up to 40% of patients through simple perioperative measures [36]. Proactive geriatrics consultations have been reported to reduce the incidence of delirium [37]. Perioperative steps to reduce the incidence of delirium include the administration of dexmedetomidine (a highly selective α2-adrenergic receptor agonist), avoidance of excessively deep anesthesia, avoidance of psychoactive substances (i.e. benzodiazepines), restricted administration of opioids perioperatively, and adequate hydration.

Malnutrition is associated with increased morbidity, prolonged hospitalization and re-admissions, prolonged surgical recovery and poorer quality of life. It is suggested, that nutrition therapy is provided in all at-risk patients to mitigate potential malnutrition-induced complications throughout the perioperative period [38].

Finally, the co-management of older surgical patients with geriatric physicians like the proactive care of older people undergoing surgery (POPS concept) has shown improved outcomes [39].

Safe in the hand of the anesthetist—really?

The anesthesia domain is in many ways similar to aircraft cockpits where effective performance demands expert knowledge, appropriate problem-solving strategies, and fine motor skills. The death rate from anesthesia alone, while once feared, is now extremely low, 0.06% for general anesthesia deaths reported in the 5th National Audit Project [40]. Anesthetists have always been leaders in patient safety, perhaps because of the immediacy and the fatality an error can result in. Understanding how to reliably deliver best practice care using established anesthetic techniques is of paramount importance [41]. Advances in anesthesia has for a long time, and will continue to involve analyzing failures and formulating strategies to address them. Work is focused on continuous improvement, a better understanding of patient outcomes, and delivery of the highest quality of care through education and training, audit, incident reporting, and the setting of standards. The establishment of the Anesthesia Patient Safety Foundation in the USA was a notable milestone in this process. Perrow [42] and Reason [43] have been influential in informing the adoption by anesthetists of the concepts of system thinking [44], incident reporting [45], and root-cause analysis [46]. It is now recognized that accidents occur, because of the complexity and the latent factors that set-up humans to fail [43]. The "blame free culture" made practitioners feel safe to report their errors, knowing that the aim is to improve safety rather than to blame individuals.

Further, great progress has been made through engineering and technology. However, few problems remain, which are not simply avoidable by advancements in engineering. Medication error is one of them. A recent major study found that 1 in 20 perioperative medication administrations resulted in a medication error, an adverse drug event or both [47]. It has been advocated to formally check every medication before administration [48]. Several recommendations for system improvements, such as bar coding or use of different sizes of syringes, or different color labeling have been proposed and already partly been implemented. However, further work is required to gain a better understanding of exactly how it is used in real work and why workarounds may occur [47, 49].

Similarly, using the World Health Organizations' Surgical Safety Checklist is strongly supported by evidence [50]. An active decision not to engage with these practices is difficult to construe as an error and we believe that patients reasonably expect anesthetists to keep up with important developments on safety.

Anesthetists work in teams and evidently, insufficient teamwork and communication is another source of error [51]. Studies show that 25% of operation room communications failed, resulting in inefficiency, waste, delay, tension, and procedural error [52]. Observational work reports failure to communicate critical information in postoperative handovers (e.g. allergies) [53]. The more frequent information is shared the less complications occur [54]. Good leadership and well-functioning healthcare teams are linked to improved patient safety [55]. One of the explicit aims of the WHO Surgical Safety Checklist is to improve teamwork, through introduction of team members and sharing of information about the patient. This may underlie much of this checklist's dramatic impact of patient safety [50].

Implications for the perioperative management of radical cystectomy

The aim to bring together the patient's values and preferences with the physician's expertise to determine the best care package for the individual is called shared decision-making. Preferences appear to be changing over time: 43%

of analyses conducted before the 1990′s found that a majority of patients preferred to participate in decisions, compared with 71% of analyses in 2000–2007 [56]. The concept has been known for a while [57], which is more an advisory discussion rather than a simple informed consent.

Directing attention to the role of the anesthetist in the entire perioperative pathway highlights the fact that decision-making is not a discrete event, but a temporally unfolding process [58]. This begins well before the anesthetist becomes involved and does not stop when the patient leaves the recovery room.

Modern shared decision-making pathways should include the referral to a high caseload center for radical cystectomies. Following indication, an anesthesia attending should be notified right afterwards, get the interdisciplinary information, provide expectation counseling and complete the preoperative assessment. Patients are then advised to engage in physical exercise at home prior to surgery. Smoking cessation has to be suggested immediately. Further measures concern the nutritional status. A prescreening according to the Nutritional Risk Screening 2002 is performed and if necessary an oral nutritional therapy is initiated. By getting the complete patients' history and results of all clinical investigations (e.g. transthoracic echocardiography, cardio pulmonary exercise testing CPET) usually weeks before the planned surgery, there is sufficient time for additional blood work and/or tests if indicated. CPET is an integrative multiorgan assessment to a ramped increase in exercise stimulus and thus provides valuable information about functional reserve. This is of importance as impaired preoperative cardiopulmonary reserve has been associated with increased postoperative major complications and use of critical care resources [59]. In case of anemia, intravenous administration of iron is implemented. This is organized in an ambulatory setting and revised by the anesthesiologists prior to hospital admission to minimize admissions of patients not suitable for surgery and hereby generating unnecessary cost and administrative effort. Furthermore, a smaller team of attending anesthetists for urologic surgery helps to ensure communication of upcoming challenging patients due to certain comorbidities.

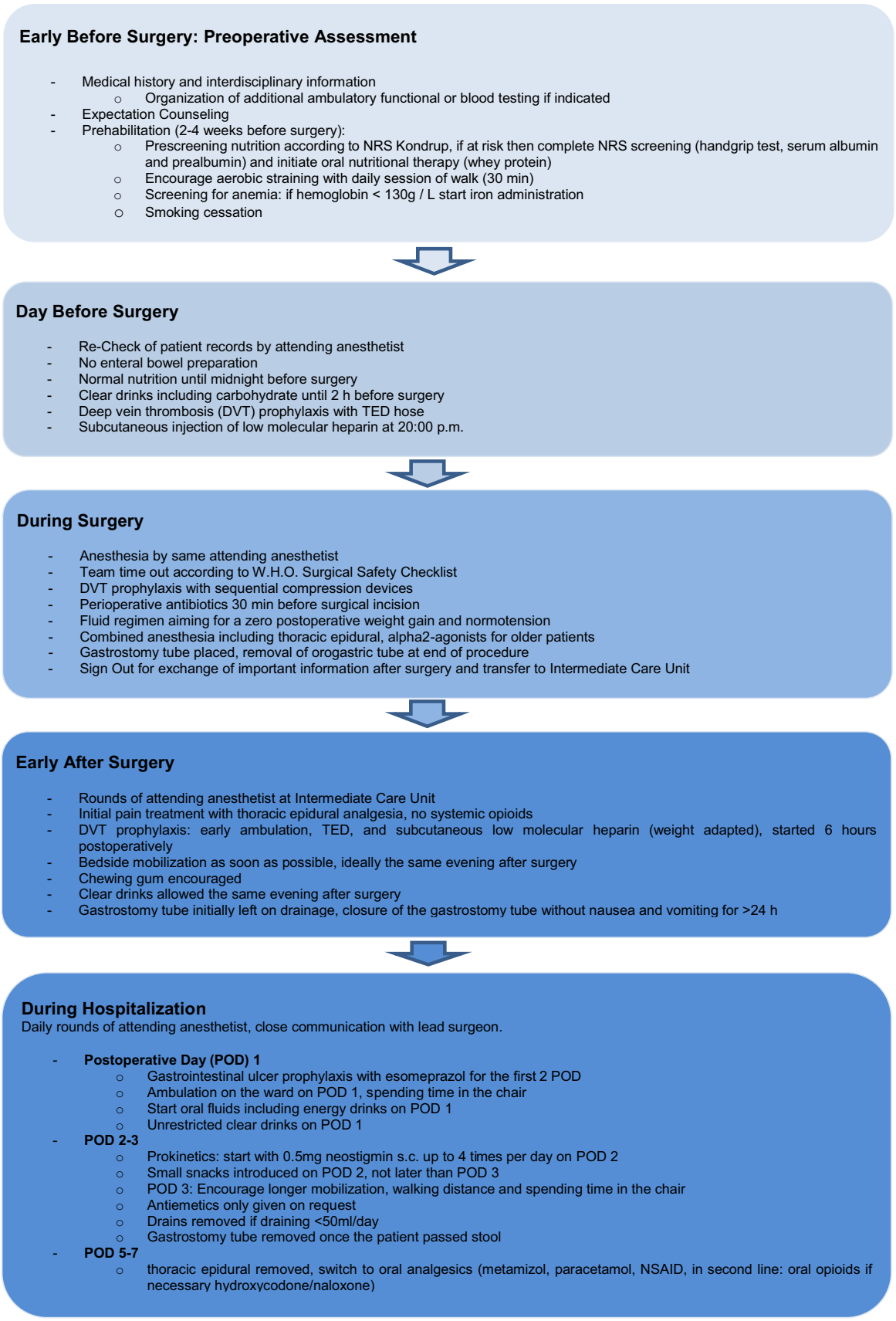
Shared decision-making pathways should clearly define a lead surgeon and anesthesiologist, who will be directly involved in the perioperative period. The same leading anesthetist should be involved in the ward rounds for pain management the following days. This way there are as few handovers as possible. From the surgical side, there should also be one senior urologist in lead during the whole hospitalization. The two disciplines have a close communication and know each other's pitfalls in the treatment. The important role of teamwork with good communication as emphasized by Weller et al. [7] and the importance of continuity with constant treating physicians as opposed to changing teams like in former days [6] is well implemented in our treatment path. Further details are presented in Fig. 2.

A cornerstone of perioperative care is fluid management. Fluids have to be considered a drug and, therefore, have to be administered for a clear indication at the right point in time and with the optimal choice and amount of fluid. These issues have been intensively debated about lately. Main indications are substitution of baseline needs and replacement of fluid loss. Different studies have shown that a restrictive fluid management can reduce complications as well as duration of hospital stay [60, 61]. This has been included in the current ERAS guidelines [62]. However, the recently published RELIEF trial could not show a higher rate of disability-free survival after major abdominal surgery using a restrictive fluid regimen compared to a liberal management yet it was associated with a higher rate of acute kidney injury [63]. The latter study was conducted in a more general abdominal surgery population compared to the trials in the homogenous radical cystectomy population, and all patients had risk factors for complications. As for radical cystectomy, current evidence still suggests that a restrictive or goal-directed therapy approach leads to a better outcome [64, 65]. In addition, the type of fluid administered affects outcomes: the use of dextran and colloids impaired coagulation resulting in greater blood loss, whereas albumin did not influence coagulation competences [66]. The use of colloids has been abolished in the ICUs in sepsis and acute kidney injury patients because of increased mortality and renal replacement therapy. However, in the elective setting the perioperative administration of the last generation balanced 6% hydroxyethyl starch solution did not affect renal function compared to the use of a 5% albumin solution [67].

Narcotic-based analgesia has been an integral component of postoperative pain control in all major surgical interventions during the last decades. Because of all its well-described negative effects [68], alternative strategies have been implemented to reduce or even eliminate the use of systemic opioids, with the ultimate aim to improve recovery.

Thoracic-epidural analgesia (TEA) provides better pain control, even in cystectomy patients, [69] compared to conventional systemic therapy. TEA has a positive effect on respiratory complications, improves return of gastrointestinal function, allows for earlier patient mobilization, improves overall mental status and patient satisfaction. TEA is an integral element in multimodal analgesia [70], and ERAS protocols, including major urologic procedures [71].

There are, however, other ways to deliver perioperative analgesia with the use of loco-regional anesthesia. The transversus abdominis plane block and the quadratus lumborum block provide excellent results in both laparoscopic and open abdominal surgery. Audenet et al. demonstrated the feasibility of a non-opioid protocol for


Early Before Surgery: Preoperative Assessment
- Medical history and interdisciplinary information
  - Organization of additional ambulatory functional or blood testing if indicated
- Expectation Counseling
- Prehabilitation (2-4 weeks before surgery):
  - Prescreening nutrition according to NRS Kondrup, if at risk then complete NRS screening (handgrip test, serum albumin and prealbumin) and initiate oral nutritional therapy (whey protein)
  - Encourage aerobic straining with daily session of walk (30 min)
  - Screening for anemia: if hemoglobin < 130g / L start iron administration
  - Smoking cessation
Day Before Surgery
- Re-Check of patient records by attending anesthetist
- No enteral bowel preparation
- Normal nutrition until midnight before surgery
- Clear drinks including carbohydrate until 2 h before surgery
- Deep vein thrombosis (DVT) prophylaxis with TED hose
- Subcutaneous injection of low molecular heparin at 20:00 p.m.
During Surgery
- Anesthesia by same attending anesthetist
- Team time out according to W.H.O. Surgical Safety Checklist
- DVT prophylaxis with sequential compression devices
- Perioperative antibiotics 30 min before surgical incision
- Fluid regimen aiming for a zero postoperative weight gain and normotension
- Combined anesthesia including thoracic epidural, alpha2-agonists for older patients
- Gastrostomy tube placed, removal of orogastric tube at end of procedure
- Sign Out for exchange of important information after surgery and transfer to Intermediate Care Unit
Early After Surgery
- Rounds of attending anesthetist at Intermediate Care Unit
- Initial pain treatment with thoracic epidural analgesia, no systemic opioids
- DVT prophylaxis: early ambulation, TED, and subcutaneous low molecular heparin (weight adapted), started 6 hours postoperatively
- Bedside mobilization as soon as possible, ideally the same evening after surgery
- Chewing gum encouraged
- Clear drinks allowed the same evening after surgery
- Gastrostomy tube initially left on drainage, closure of the gastrostomy tube without nausea and vomiting for >24 h
During Hospitalization
Daily rounds of attending anesthetist, close communication with lead surgeon.
- Postoperative Day (POD) 1
  - Gastrointestinal ulcer prophylaxis with esomeprazol for the first 2 POD
  - Ambulation on the ward on POD 1, spending time in the chair
  - Start oral fluids including energy drinks on POD 1
  - Unrestricted clear drinks on POD 1
- POD 2-3
  - Prokinetics: start with 0.5mg neostigmin s.c. up to 4 times per day on POD 2
  - Small snacks introduced on POD 2, not later than POD 3
  - POD 3: Encourage longer mobilization, walking distance and spending time in the chair
  - Antiemetics only given on request
  - Drains removed if draining <50ml/day
  - Gastrostomy tube removed once the patient passed stool
- POD 5-7
  - thoracic epidural removed, switch to oral analgesics (metamizol, paracetamol, NSAID, in second line: oral opioids if necessary hydroxycodone/naloxone)

◂**Fig. 2** 2019 Cystectomy Enhanced Recovery Approach (CERA©) at the University Department of Urology, Bern, Switzerland, with implemented perioperative medicine cornerstones according to The Royal College of Anaesthetists [4, 75]. *DVT* deep vein thrombosis, *POD* postoperative day, *T.E.D.* anti-embolism stockings

patients undergoing robot-assisted radical cystectomy using a peripheral nerve block technique [72].

Further pharmacologic agents that reduce the opioid requirements and their complications are gabapentinoids, NSAIDs, acetaminophen, ketamine, intravenous lidocaine and alpha-2-agonists [73]. Noteworthy are especially the use of ketamine, which led to an important reduction in morphine consumption postoperatively, and dexmedetomidine, where numerous studies have shown benefits in multimodal opioid-sparing analgesic pathway [73].

A high caseload guarantees not only routine in the manual performance of invasive procedures for anesthetists and surgeons, but also knowledge of the exact separate steps of the surgical procedure on the anesthetist's side. This helps us to anticipate and take an active role to support the surgeon from the outpatient clinic until discharge. Ahmad et al. showed that high caseload centers have a lower complication rate, and if a complication occurs a lower rate of failure-to-rescue; this together adds up to a lower mortality [74].

It is the anesthetists' important role as a key player to chaperone the patient in this sometimes frightening perioperative process since he has the general view over physiological and psychological aspects and resources with all their possible consequences for the patients' well-being.

Challenges in future

As stated by Weller et al. [7], the system has improved so much that it is rarely the cause for errors, but rather lack of engagement to existing guidelines. In times of high pressure on health care cost and, therefore, less time for patient contact, it is very perilous that this cause for errors will gain even more importance. It is also a big challenge to organize a perioperative pathway efficiently at a big tertiary care center. The bigger the hospital the more structured and institutionalized the pathways have to be.

So far, the acceptance of prehabilitation is not established enough to provide for the cost caused, e.g. by preoperative physical therapy before the operation. With more and more evidence for prehabilitation published in recent years, this is to change soon hopefully. However, special attention should be paid to not delaying surgery. Prehabilitation starts when surgery is decided, this is a run against time and tumor.

Conclusion

Radical cystectomy is a complex major abdominal surgery that requires optimal interdisciplinary perioperative care starting at the time of indication for surgery and lasting until full functional recovery. The anesthetist's role is crucial for the preoperative risk assessment, planning of further investigations, perioperative management and postoperative analgesia to accelerate recovery. We have come a far way with implementing steps to achieve this. However, there is still much room for improvement, e.g. by institutionalization of the above-mentioned perioperative processes.

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Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

Research involving human participants and/or animals This is a review article not directly involving human participants or animals.

Informed consent Not applicable.

References

1. Grocott MP, Pearse RM (2012) Perioperative medicine: the future of anaesthesia? Br J Anaesth 108(5):723–726. https://doi.org/10.1093/bja/aes124
2. Kehlet H, Delaney CP, Hill AG (2015) Perioperative medicine—the second round will need a change of tactics. Br J Anaesth 115(1):13–14. https://doi.org/10.1093/bja/aev098
3. Grocott MPW, Edwards M, Mythen MG, Aronson S (2019) Perioperative care pathways: re-engineering care to achieve the 'triple aim'. Anaesthesia 74(Suppl 1):90–99. https://doi.org/10.1111/anae.14513
4. Mythen M, Berry C, Drake S, Griffiths R, Grocott M, Larsen S, Mahajan R, Pearse R (2015) Perioperative medicine: the pathway to better surgical care. Royal College of Anaesthetists, London
5. Leow JJ, Bedke J, Chamie K, Collins JW, Daneshmand S, Grivas P, Heidenreich A, Messing EM, Royce TJ, Sankin AI, Schoenberg MP, Shipley WU, Villers A, Efstathiou JA, Bellmunt J, Stenzl A (2019) SIU-ICUD consultation on bladder cancer: treatment of muscle-invasive bladder cancer. World J Urol 37(1):61–83. https://doi.org/10.1007/s00345-018-2606-y
6. Levy N, Grocott MPW, Carli F (2019) Patient optimisation before surgery: a clear and present challenge in peri-operative care. Anaesthesia 74(Suppl 1):3–6. https://doi.org/10.1111/anae.14502
7. Weller JM, Merry AF (2013) I. Best practice and patient safety in anaesthesia. Br J Anaesth 110(5):671–673. https://doi.org/10.1093/bja/aet011
8. Porter ME, Kaplan RS (2016) How to pay for health care. Harv Bus Rev 94(7–8):88–98, 100, 134

9. Siddiqi A, White PB, Mistry JB, Gwam CU, Nace J, Mont MA, Delanois RE (2017) Effect of bundled payments and health care reform as alternative payment models in total joint arthroplasty: a clinical review. J Arthroplasty 32(8):2590–2597. https://doi.org/10.1016/j.arth.2017.03.027
10. Lucas DJ, Pawlik TM (2014) Quality improvement in gastrointestinal surgical oncology with American College of Surgeons National Surgical Quality Improvement Program. Surgery 155(4):593–601. https://doi.org/10.1016/j.surg.2013.12.001
11. Djaladat H, Katebian B, Bazargani ST, Miranda G, Cai J, Schuckman AK, Daneshmand S (2017) 90-day complication rate in patients undergoing radical cystectomy with enhanced recovery protocol: a prospective cohort study. World J Urol 35(6):907–911. https://doi.org/10.1007/s00345-016-1950-z
12. Burnside WS, Snowden C (2014) Preoperative assessment and investigation. Surgery (Oxford) 32(2):63–68. https://doi.org/10.1016/j.mpsur.2013.12.001
13. Kaiser H, Zurron N, Beilstein C, Vetter C, Rieder H (2018) Präoperative kardiale Risikoevaluation vor elektiven nicht-herzchirurgischen. Eingriffen Swiss Med Forum 18(36):725–732. https://doi.org/10.4414/smf.2018.03329
14. Verma R, Kee M, Hartle A, Alladi V, Rollin A-M, Meakin G, Struthers R, Carlisle J, Johnston P, Rivett K, Hurley C (2010) Pre-operative assessment and patient preparation—the role of the anaesthetist. The Association of Anaesthetists of Great Britain and Ireland, London
15. Qaseem A, Snow V, Fitterman N, Hornbake ER, Lawrence VA, Smetana GW, Weiss K, Owens DK, Aronson M, Barry P, Casey DE Jr, Cross JT Jr, Fitterman N, Sherif KD, Weiss KB (2006) Risk assessment for and strategies to reduce perioperative pulmonary complications for patients undergoing noncardiothoracic surgery: a guideline from the American College of Physicians. Ann Intern Med 144(8):575–580
16. Kohl BA, Schwartz S (2009) Surgery in the patient with endocrine dysfunction. Med Clin N Am 93(5):1031–1047. https://doi.org/10.1016/j.mcna.2009.05.003
17. Kristensen SD, Knuuti J, Saraste A, Anker S, Botker HE, Hert SD, Ford I, Gonzalez-Juanatey JR, Gorenek B, Heyndrickx GR, Hoeft A, Huber K, Iung B, Kjeldsen KP, Longrois D, Luscher TF, Pierard L, Pocock S, Price S, Roffi M, Sirnes PA, Sousa-Uva M, Voudris V, Funck-Brentano C (2014) 2014 ESC/ESA Guidelines on non-cardiac surgery: cardiovascular assessment and management: the Joint Task Force on non-cardiac surgery: cardiovascular assessment and management of the European Society of Cardiology (ESC) and the European Society of Anaesthesiology (ESA). Eur Heart J 35(35):2383–2431. https://doi.org/10.1093/eurheartj/ehu282
18. NICE Guidelines (NG 45) (2016) Routine preoperative tests for elective surgery. National Institute for Health and Care Exellence, London
19. Moran J, Wilson F, Guinan E, McCormick P, Hussey J, Moriarty J (2016) Role of cardiopulmonary exercise testing as a risk-assessment method in patients undergoing intra-abdominal surgery: a systematic review. Br J Anaesth 116(2):177–191. https://doi.org/10.1093/bja/aev454
20. Lawrence VA, Hazuda HP, Cornell JE, Pederson T, Bradshaw PT, Mulrow CD, Page CP (2004) Functional independence after major abdominal surgery in the elderly. J Am Coll Surg 199(5):762–772. https://doi.org/10.1016/j.jamcollsurg.2004.05.280
21. Nicholson A, Lowe MC, Parker J, Lewis SR, Alderson P, Smith AF (2014) Systematic review and meta-analysis of enhanced recovery programmes in surgical patients. Br J Surg 101(3):172–188. https://doi.org/10.1002/bjs.9394
22. Grocott MP, Mythen MG (2015) Perioperative medicine: the value proposition for anesthesia?: a UK perspective on delivering value from anesthesiology. Anesthesiol Cli 33(4):617–628. https://doi.org/10.1016/j.anclin.2015.07.003
23. Scheede-Bergdahl C, Minnella EM, Carli F (2019) Multi-modal prehabilitation: addressing the why, when, what, how, who and where next? Anaesthesia 74(Suppl 1):20–26. https://doi.org/10.1111/anae.14505
24. Santa Mina D, Clarke H, Ritvo P, Leung YW, Matthew AG, Katz J, Trachtenberg J, Alibhai SM (2014) Effect of total-body prehabilitation on postoperative outcomes: a systematic review and meta-analysis. Physiotherapy 100(3):196–207. https://doi.org/10.1016/j.physio.2013.08.008
25. Moran J, Guinan E, McCormick P, Larkin J, Mockler D, Hussey J, Moriarty J, Wilson F (2016) The ability of prehabilitation to influence postoperative outcome after intra-abdominal operation: a systematic review and meta-analysis. Surgery 160(5):1189–1201. https://doi.org/10.1016/j.surg.2016.05.014
26. Howard R, Yin YS, McCandless L, Wang S, Englesbe M, Machado-Aranda D (2019) Taking control of your surgery: impact of a prehabilitation program on major abdominal surgery. J Am Coll Surg 228(1):72–80. https://doi.org/10.1016/j.jamcollsurg.2018.09.018
27. Gillis C, Buhler K, Bresee L, Carli F, Gramlich L, Culos-Reed N, Sajobi TT, Fenton TR (2018) Effects of nutritional prehabilitation, with and without exercise, on outcomes of patients who undergo colorectal surgery: a systematic review and meta-analysis. Gastroenterology 155(2):391–410.e394. https://doi.org/10.1053/j.gastro.2018.05.012
28. Rammant E, Decaestecker K, Bultijnck R, Sundahl N, Ost P, Pauwels NS, Deforche B, Pieters R, Fonteyne V (2018) A systematic review of exercise and psychosocial rehabilitation interventions to improve health-related outcomes in patients with bladder cancer undergoing radical cystectomy. Clin Rehabil 32(5):594–606. https://doi.org/10.1177/0269215517746472
29. Aubrun F, Gazon M, Schoeffler M, Benyoub K (2012) Evaluation of perioperative risk in elderly patients. Miner Anestesiol 78(5):605–618
30. Monson K, Litvak DA, Bold RJ (2003) Surgery in the aged population: surgical oncology. Arch Surg (Chicago, Ill: 1960) 138(10):1061–1067. https://doi.org/10.1001/archsurg.138.10.1061
31. Leung JM, Dzankic S (2001) Relative importance of preoperative health status versus intraoperative factors in predicting postoperative adverse outcomes in geriatric surgical patients. J Am Geriatr Soc 49(8):1080–1085
32. Bettelli G (2011) Preoperative evaluation in geriatric surgery: comorbidity, functional status and pharmacological history. Miner Anestesiol 77(6):637–646
33. Lascano D, Pak JS, Kates M, Finkelstein JB, Silva M, Hagen E, RoyChoudhury A, Bivalacqua TJ, DeCastro GJ, Benson MC, McKiernan JM (2015) Validation of a frailty index in patients undergoing curative surgery for urologic malignancy and comparison with other risk stratification tools. Urol Oncol 33(10):426 e421412. https://doi.org/10.1016/j.urolonc.2015.06.002
34. Palmer RM (2009) Perioperative care of the elderly patient: an update. Clevel Clin J Med 76(Suppl 4):S16–21. https://doi.org/10.3949/ccjm.76.s4.03
35. Dasgupta M, Dumbrell AC (2006) Preoperative risk assessment for delirium after noncardiac surgery: a systematic review. J Am Geriatr Soc 54(10):1578–1589. https://doi.org/10.1111/j.1532-5415.2006.00893.x
36. Mohanty S, Rosenthal R, Russell M, Neuman M, Ko C, Esnaola N (2016) Optimal perioperative management of the geriatric patient: best practice guideline from ACS/NSQIP/American Geriatrics Society American College of Surgeons. https://www.facs.org/~/media/files/quality%20programs/geriatric/acs%20nsqip%20geriatric%202016%20guidelines.ashx.

37. Marcantonio ER, Flacker JM, Wright RJ, Resnick NM (2001) Reducing delirium after hip fracture: a randomized trial. J Am Geriatr Soc 49(5):516–522
38. McClave SA, Kozar R, Martindale RG, Heyland DK, Braga M, Carli F, Drover JW, Flum D, Gramlich L, Herndon DN, Ko C, Kudsk KA, Lawson CM, Miller KR, Taylor B, Wischmeyer PE (2013) Summary points and consensus recommendations from the North American Surgical Nutrition Summit. J Parenter Enteral Nutr 37(5 Suppl):99s–105s. https://doi.org/10.1177/0148607113495892
39. Braude P, Goodman A, Elias T, Babic-Illman G, Challacombe B, Harari D, Dhesi JK (2017) Evaluation and establishment of a ward-based geriatric liaison service for older urological surgical patients: proactive care of Older People undergoing Surgery (POPS)-Urology. BJU Int 120(1):123–129. https://doi.org/10.1111/bju.13526
40. Sury MR, Palmer JH, Cook TM, Pandit JJ (2014) The state of UK anaesthesia: a survey of National Health Service activity in 2013. Br J Anaesth 113(4):575–584. https://doi.org/10.1093/bja/aeu292
41. Bion JF, Abrusci T, Hibbert P (2010) Human factors in the management of the critically ill patient. Br J Anaesth 105(1):26–33. https://doi.org/10.1093/bja/aeq126
42. Perrow C (1984) Normal accidents—living with high risk technologies. Basic Books, New York
43. Reason J (1995) Understanding adverse events: human factors. Qual Health Care 4(2):80–89
44. Gaba DM, Maxwell M, DeAnda A (1987) Anesthetic mishaps: breaking the chain of accident evolution. Anesthesiology 66(5):670–676
45. Cooper JB, Long CD, Newbower RS, Philip JH (1982) Critical incidents associated with intraoperative exchanges of anesthesia personnel. Anesthesiology 56(6):456–461
46. Bagian JP, Gosbee J, Lee CZ, Williams L, McKnight SD, Mannos DM (2002) The veterans Affairs root cause analysis system in action. Jt Comm J Qual Improv 28(10):531–545
47. Nanji KC, Patel A, Shaikh S, Seger DL, Bates DW (2016) Evaluation of perioperative medication errors and adverse drug events. Anesthesiology 124(1):25–34. https://doi.org/10.1097/aln.0000000000000904
48. Jensen LS, Merry AF, Webster CS, Weller J, Larsson L (2004) Evidence-based strategies for preventing drug administration errors during anaesthesia. Anaesthesia 59(5):493–504. https://doi.org/10.1111/j.1365-2044.2004.03670.x
49. Wahr JA, Abernathy JH 3rd, Lazarra EH, Keebler JR, Wall MH, Lynch I, Wolfe R, Cooper RL (2017) Medication safety in the operating room: literature and expert-based recommendations. Br J Anaesth 118(1):32–43. https://doi.org/10.1093/bja/aew379
50. Haynes AB, Weiser TG, Berry WR, Lipsitz SR, Breizat AH, Dellinger EP, Herbosa T, Joseph S, Kibatala PL, Lapitan MC, Merry AF, Moorthy K, Reznick RK, Taylor B, Gawande AA (2009) A surgical safety checklist to reduce morbidity and mortality in a global population. N Engl J Med 360(5):491–499. https://doi.org/10.1056/NEJMsa0810119
51. Salas E, DiazGranados D, Weaver SJ, King H (2008) Does team training work? Principles for health care. Acad Emerg Med 15(11):1002–1009. https://doi.org/10.1111/j.1553-2712.2008.00254.x
52. Lingard L, Espin S, Whyte S, Regehr G, Baker GR, Reznick R, Bohnen J, Orser B, Doran D, Grober E (2004) Communication failures in the operating room: an observational classification of recurrent types and effects. Qual Saf Health Care 13(5):330–334. https://doi.org/10.1136/qhc.13.5.330
53. Schwilk B, Gravenstein N, Blessing S, Friesdorf W (1994) Postoperative information transfer: a study comparing two university hospitals. Int J Clin Monit Comput 11(3):145–149
54. Mazzocco K, Petitti DB, Fong KT, Bonacum D, Brookey J, Graham S, Lasky RE, Sexton JB, Thomas EJ (2009) Surgical team behaviors and patient outcomes. Am J Surg 197(5):678–685. https://doi.org/10.1016/j.amjsurg.2008.03.002
55. Künzle B, Kolbe M, Grote G (2010) Ensuring patient safety through effective leadership behaviour: a literature review. Saf Sci 48(1):1–17. https://doi.org/10.1016/j.ssci.2009.06.004
56. Chewning B, Bylund CL, Shah B, Arora NK, Gueguen JA, Makoul G (2012) Patient preferences for shared decisions: a systematic review. Patient Educ Couns 86(1):9–18. https://doi.org/10.1016/j.pec.2011.02.004
57. Sturgess J, Clapp JT, Fleisher LA (2019) Shared decision-making in peri-operative medicine: a narrative review. Anaesthesia 74(Suppl 1):13–19. https://doi.org/10.1111/anae.14504
58. Clapp JT, Arriaga AF, Murthy S, Raper SE, Schwartz JS, Barg FK, Fleisher LA (2019) Surgical consultation as social process: implications for shared decision making. Ann Surg 269(3):446–452. https://doi.org/10.1097/sla.0000000000002610
59. Prentis JM, Trenell MI, Vasdev N, French R, Dines G, Thorpe A, Snowden CP (2013) Impaired cardiopulmonary reserve in an elderly population is related to postoperative morbidity and length of hospital stay after radical cystectomy. BJU Int 112(2):E13–19. https://doi.org/10.1111/bju.12219
60. Wuethrich PY, Burkhard FC, Thalmann GN, Stueber F, Studer UE (2014) Restrictive deferred hydration combined with preemptive norepinephrine infusion during radical cystectomy reduces postoperative complications and hospitalization time: a randomized clinical trial. Anesthesiology 120(2):365–377. https://doi.org/10.1097/ALN.0b013e3182a44440
61. Brandstrup B, Tonnesen H, Beier-Holgersen R, Hjortso E, Ording H, Lindorff-Larsen K, Rasmussen MS, Lanng C, Wallin L, Iversen LH, Gramkow CS, Okholm M, Blemmer T, Svendsen PE, Rottensten HH, Thage B, Riis J, Jeppesen IS, Teilum D, Christensen AM, Graungaard B, Pott F, Danish Study Group on Perioperative Fluid T (2003) Effects of intravenous fluid restriction on postoperative complications: comparison of two perioperative fluid regimens: a randomized assessor-blinded multicenter trial. Ann Surg 238(5):641–648. https://doi.org/10.1097/01.sla.0000094387.50865.23
62. Feldheiser A, Aziz O, Baldini G, Cox BP, Fearon KC, Feldman LS, Gan TJ, Kennedy RH, Ljungqvist O, Lobo DN, Miller T, Radtke FF, Ruiz Garces T, Schricker T, Scott MJ, Thacker JK, Ytrebo LM, Carli F (2016) Enhanced Recovery After Surgery (ERAS) for gastrointestinal surgery, part 2: consensus statement for anaesthesia practice. Acta Anaesthesiol Scand 60(3):289–334. https://doi.org/10.1111/aas.12651
63. Myles PS, Bellomo R, Corcoran T, Forbes A, Peyton P, Story D, Christophi C, Leslie K, McGuinness S, Parke R, Serpell J, Chan MTV, Painter T, McCluskey S, Minto G, Wallace S (2018) Restrictive versus liberal fluid therapy for major abdominal surgery. N Engl J Med 378(24):2263–2274. https://doi.org/10.1056/NEJMoa1801601
64. Wuethrich PY, Burkhard FC (2015) New perioperative fluid and pharmacologic management protocol results in reduced blood loss, faster return of bowel function, and overall recovery. Curr Urol Rep 16(4):17. https://doi.org/10.1007/s11934-015-0490-1
65. Pillai P, McEleavy I, Gaughan M, Snowden C, Nesbitt I, Durkan G, Johnson M, Cosgrove J, Thorpe A (2011) A double-blind randomized controlled clinical trial to assess the effect of Doppler optimized intraoperative fluid management on outcome following radical cystectomy. J Urol 186(6):2201–2206. https://doi.org/10.1016/j.juro.2011.07.093
66. Rasmussen KC, Secher NH, Pedersen T (2016) Effect of perioperative crystalloid or colloid fluid therapy on hemorrhage, coagulation competence, and outcome: a systematic review and stratified

meta-analysis. Medicine 95(31):e4498. https://doi.org/10.1097/MD.0000000000004498
67. Kammerer T, Brettner F, Hilferink S, Hulde N, Klug F, Pagel J, Karl A, Crispin A, Hofmann-Kiefer K, Conzen P, Rehm M (2018) No differences in renal function between balanced 6% hydroxyethyl starch (130/0.4) and 5% albumin for volume replacement therapy in patients undergoing cystectomy: a randomized controlled trial. Anesthesiology 128(1):67–78. https://doi.org/10.1097/ALN.0000000000001927
68. Khademi H, Kamangar F, Brennan P, Malekzadeh R (2016) Opioid therapy and its side effects: a review. Arch Iran Med 19(12):870–876
69. Winer AG, Sfakianos JP, Puttanniah VG, Bochner BH (2015) Comparison of perioperative outcomes for epidural versus intravenous patient-controlled analgesia after radical cystectomy. Reg Anesth Pain Med 40(3):239–244. https://doi.org/10.1097/AAP.0000000000000219
70. Weiss R, Popping DM (2018) Is epidural analgesia still a viable option for enhanced recovery after abdominal surgery. Curr Opin Anaesthesiol 31(5):622–629. https://doi.org/10.1097/aco.0000000000000640
71. Vukovic N, Dinic L (2018) Enhanced recovery after surgery protocols in major urologic surgery. Front Med 5:93. https://doi.org/10.3389/fmed.2018.00093
72. Audenet F, Attalla K, Giordano M, Pfail J, Lubin MA, Waingankar N, Gainsburg D, Badani KK, Sim A, Sfakianos JP (2019) Prospective implementation of a nonopioid protocol for patients undergoing robot-assisted radical cystectomy with extracorporeal urinary diversion. Urol Oncol 37(5):300.e317–300.e323. https://doi.org/10.1016/j.urolonc.2019.02.002
73. Gabriel RA, Swisher MW, Sztain JF, Furnish TJ, Ilfeld BM, Said ET (2019) State of the art opioid-sparing strategies for post-operative pain in adult surgical patients. Expert Opin Pharmacother 20(8):949–961. https://doi.org/10.1080/14656566.2019.1583743
74. Ahmad T, Bouwman RA, Grigoras I, Aldecoa C, Hofer C, Hoeft A, Holt P, Fleisher LA, Buhre W, Pearse RM (2017) Use of failure-to-rescue to identify international variation in postoperative care in low-, middle- and high-income countries: a 7-day cohort study of elective surgery. Br J Anaesth 119(2):258–266. https://doi.org/10.1093/bja/aex185
75. Loffel LM, Kleeb B, Burkhard FC, Wuethrich PY (2014) Perioperative use of crystalloids in patients undergoing open radical cystectomy: balanced Ringer's maleate versus a glucose 5%/potassium-based balanced solution: study protocol for a randomized controlled trial. Trials 15:276. https://doi.org/10.1186/1745-6215-15-276