Anesthesia for Major Urologic Surgery

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KEYWORDS

• Enhanced recovery • Shared decision making • Surgical approach • Robot assisted • Laparoscopic • Prostatectomy • Cystectomy • Robotic prostatectomy

KEY POINTS

- Anesthesia for major urology surgery has changed greatly with the advent of laparoscopic and robot-assisted surgical techniques.
- Enhanced recovery pathways are now established in complex major urologic surgery and are reducing lengths of stay and postoperative complications. This model is extremely important to deliver optimal health care from the decision to operate to the return to normal patient function.
- Anesthetic considerations differ between established robotic surgical centers and those still perfecting the older approach (operative times much greater).
- The success of enhanced recovery pathways in urologic surgery depends upon preoperative assessment, preparation and compliance with all the perioperative elements. Attention to detail and fastidious preparation are the keys to successful anesthesia and outcomes in robotic surgery.

PATIENT POPULATION

The mean age for patients undergoing cystectomy is 60 years. This age is typical of the population of men undergoing major urologic surgery. The patients affected are an elderly cohort, usually with multiple significant comorbidities. They often have a malignancy, associated renal dysfunction, and present a challenge to the anesthetist in the perioperative setting.

ENHANCED RECOVERY CARE PATHWAY

Most surgical pathways in the United Kingdom are now based on the principles of enhanced recovery.[1,2] This care pathway begins when the patient is still at home, before surgery, and does not end until the patient has returned to the presurgery functional status.

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The preassessment process follows and places the emphasis on the shared decision making that underpins this approach to perioperative care. This process covers various generic issues but may also involve individual risk stratification, cardiopulmonary exercise testing, perioperative management of anticoagulants, and assessment of postoperative high dependency requirements. The patient's health status is also optimized by management of anemia, glycemic control, and treatment of hypertension, as well as dietary, weight, and smoking-cessation advice before surgery.

A consultant-led, multidisciplinary decision can be made as to which procedure and approach is required for each patient.

Major urologic surgery has 2 main categories:

- Upper tract surgery: simple or radical nephrectomy, radical nephroureterectomy, nephron-sparing surgery
- Pelvic surgery: radical cystectomy with urinary diversion and radical prostatectomy

The surgical approach to these procedures differs greatly and there has been rapid adoption of minimally invasive surgery in recent years, particularly with the advent of robot-assisted surgery. The procedure as well as the approach therefore influence the anesthetic techniques recommended.

The authors' unit has been a designated cancer center since 2005 and undertakes approximately 300 robotic pelvic cases per year.[3] All cystectomies and prostatectomies are now completed robotically, and the unit has been a national leader in enhanced recovery with one of the shortest lengths of stay in the United Kingdom for radical pelvic surgery.

This unit has ceased using intraoperative cell salvage for cystectomies, because the blood transfusion requirement in robotics has been minimal, decreasing length of stay and cost.

Latest advances include the introduction of day-case robotically assisted laparoscopic prostatectomy.

All patients requiring radical cystectomy undergo preoperative cardiopulmonary exercise testing, and this allows risk stratification for the planned level of dependency in the postoperative period. The high-dependency setting is only used in those patients identified as high risk.

Most radical nephrectomies and nephron-sparing surgery are now performed by laparoscopic or robotically assisted laparoscopic approach. Open renal surgery is reserved for tumors involving the inferior vena cava or large, centrally placed tumors requiring partial nephrectomy for which a laparoscopic approach is not feasible.

SPECIFIC ANESTHETIC CONSIDERATIONS FOR OPEN PROCEDURES

- Blood loss: use of intraoperative cell salvage, transfusion requirements[3]
- Pain relief: preemptive, intraoperative, and postoperative (multimodal)
- Regional anesthesia: rectus sheath catheters[4] (placed by the anesthetist using ultrasonography), resulting in earlier mobilization than thoracic epidural anesthesia
- Heat loss: forced-air warmers, fluid warming devices

SPECIFIC CONSIDERATIONS FOR LAPAROSCOPIC PROCEDURES

- Pneumoperitoneum: cardiovascular stability, hypercarbia, postoperative pain
- Potential for concealed bleeding

As with any laparoscopic surgery, issues with ventilation, maintenance of normocapnia, and cardiovascular stability can occur during any urologic procedure involving

pneumoperitoneum. Because of the prolonged nature of the surgery in urology, problems with hypercarbia, vagally mediated bradycardia, and postoperative shoulder tip pain are more common.

It is also important to understand that significant surgical bleeding can be masked when operating laparoscopically, and can be much more difficult to control, should it occur.

ROBOT-ASSISTED SURGERY

Robotic surgery is gaining dominance over the conventional laparoscopic approach for most pelvic procedures and nephron-sparing surgery.[5] The surgeon operates from a nonsterile, seated control unit that is separate from the robot. The operating arms are positioned between the legs of the patient and a steep head-down (Trendelenburg) lithotomy position is required to prevent abdominal contents from obscuring the view of the pelvis. Four operating arms attached to intra-abdominal ports extend over the patient. These ports remain in place for the duration of the procedure and the instruments, inserted via the ports, are manipulated by the magnified movements of the surgeon in the control unit (**Fig. 1**).

Differences from traditional laparoscopic surgery:

- Emergency access to patient: a plan to disengage instruments, remove the trocars, and unlock the robot, before leveling the patient, must be decided, communicated, and rehearsed for any airway emergency or cardiac arrest scenario.
- Muscle relaxation: maintenance of neuromuscular block and complete avoidance of patient movement is mandatory while the fixed trocars are in place, to avoid potential tissue injury.

Specific Considerations for Robot-assisted Surgery

Complications/concerns with robot-assisted surgery[6]:

Prolonged lithotomy position predisposes to:

- Lower (and rarely upper) extremity nerve injury (particularly femoral nerve)
- Pressure areas and compartment syndrome of the lower limbs

Prolonged Trendelenburg[7] predisposes to:

- Ocular injury including corneal abrasions and ischemic optic neuropathy caused by high intraocular pressures[8–10]
- Laryngeal (and facial) edema and respiratory distress

Fig. 1. Positioning for robotics.

- Risk of cerebral edema, as well as increased intracranial pressure, due to reduction in cerebral venous return due to the high intra-abdominal pressures and head-down position
- Decreased functional residual capacity and decreased pulmonary compliance causing increased ventilatory pressures and increased atelectasis

Prolonged pneumoperitoneum predisposes to:

- Carbon dioxide subcutaneous emphysema (up to 4% of cases)
- Carbon dioxide air embolism is also possible[11,12]

NEPHRECTOMY

Most patients undergoing nephrectomy are presenting with renal cancer. These patients must be screened for other comorbidities or mass lesions and invasion into any other tissues, in order to plan not only the appropriate surgical procedure and postoperative management plan but also the choice of anesthetic. They have often been identified via screening and present asymptomatically, but can be a complex cohort of patients, who must be managed by an experienced team.

These patients are positioned laterally (operative side up) for the procedure in most cases, although in recent times the breaking of the table has not been widely used.

ANESTHETIC TEMPLATE

A template for the anesthetic management of robot-assisted prostatectomy is detailed later. Significant differences in anesthetic and surgical management of patients undergoing other major urologic procedures is also outlined for completeness.

ROBOT-ASSISTED SURGERY

Duration: approximately 3 to 4 hours (surgical time, 2–3 hours)
Incision: multiple robotic-arm trocars with surgical instruments attached
Positioning: steep head-down lithotomy (approximately 27°), arms wrapped by sides

Recommended Techniques

Preoperative visit

- Consent for spinal under general anesthetic: performed at end of operation if prostate has been difficult to dissect and the bladder is thin walled, which would increase the likelihood of postoperative bladder spasm, which is otherwise difficult to treat (shared decision making between surgeon and anesthetist)
- Warn patient about sore throat, due to the endotracheal tube, facial edema, catheter insertion, lower abdominal (and sometimes penile) pain, and the need for early mobilization

PREMEDICATION

- Drugs to reduce gastric acid and increase gastric emptying (eg, omeprazole 40 mg by mouth and metoclopramide 10 mg by mouth)
- Addition of preemptive analgesia after consent is obtained (eg, oxycodone 15 mg by mouth)

ANESTHETIC ROOM

- Thromboembolic stockings (if not contraindicated)

- All invasive lines on 1 side (opposite side to robot assistant; usually the left) for less interference during procedure (normally a 16G intravenous cannula and 20G arterial cannula)
- Anesthetize patient on the surgical table, lying directly on gel pad, with gel head support
- General anesthesia, endotracheal tube (taped not tied to avoid cerebral venous congestion), positive pressure ventilation (optimal positive end-expiratory pressure)
- Orogastric tube (for gastric deflation) and oral temperature probe
- Saline-soaked ribbon gauze throat pack (to protect against gastric contents refluxing up lacrimal ducts and causing corneal burns)
- Eye protection with lubricating ointment, tape, and padding
- Padded right-angled bar placed just caudad to the patient's chin to protect head from surgical instruments
- Arms wrapped by patient's sides, which limits intraoperative access: plan lines appropriately and attach patient identification to forehead after routine safety checks
- Arterial transducer on board fixed at the level of the shoulder

INTRAOPERATIVE

- Forced-air warmer to upper chest and fluid warmer
- Bolsters under knees (Fig. 2), gel pads under ankles, and calf pumps
- Steep head-down position (try for 27°, depending on patient body habitus and ventilatory pressures); some centers use shoulder bolsters
- Preincision surgical antibiotic prophylaxis as per local protocol
- IV dexamethasone to decrease inflammation and swelling
- Consider antisialagogue of choice - not routinely used (eg, IV glycopyrrolate 200 mg, which decreases secretions and the chance of bradyarrhythmias with pneumoperitoneum and remifentanil infusion)
- Buscopan reduces bladder spasm in recovery (can increase heart rate)
- Remifentanil infusion with volatile maintenance in oxygen/air mix is used most commonly
- With careful attention to airway pressures, a second dose of muscle relaxant is rarely required

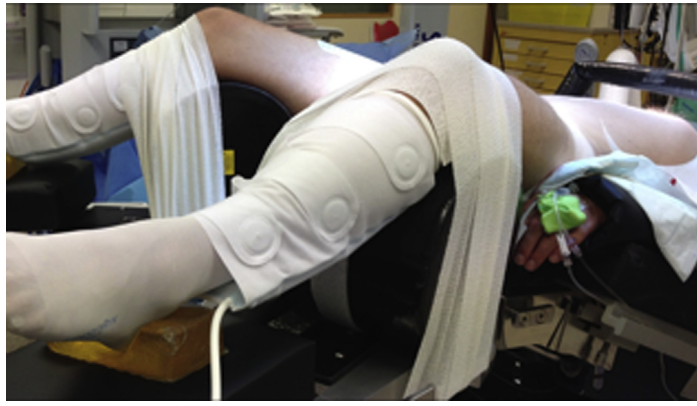

Fig. 2. Leg bolsters on table.

FLUID THERAPY

- Limit fluid therapy during procedure while lower renal tract is disrupted. For most surgery this requires less than 800 mL. Then administer up to 1200 mL (approximately) of crystalloid once urethra is reconnected by the surgeon (communicate closely): total 2000 mL
- Blood loss is usually less than 300 mL

SURGICAL CONCLUSION

- Administer antiemetic and analgesics (eg, IV ondansetron 4 mg, IV paracetamol 1 g, IV nonsteroidal antiinflammatory drug [NSAID] of choice, and IV oxycodone); often give small dose of furosemide to stimulate diuresis
- As soon as robot is disengaged, flatten patient out and perform recruitment maneuvers to the lungs
- Consider spinal after discussion with surgeon before emergence (if bladder spasm is a problem, spinal is advised): no opiate, aim to cover 3 hours after surgery
- Sit patient up as soon as surgery is complete: slow wake up over 10 to 15 minutes while remifentanil action wears off (this period reduces cerebral edema and risk of agitation and confusion postoperatively)
- Ensure normocapnia and cuff leak before extubation

POSTOPERATIVE PRESCRIPTION

- Postoperative pain is normally only mild to moderate
- Regular multimodal analgesia, antiemetic, and venous thromboembolic prophylaxis (eg, oxycodone 10–15 mg by mouth twice a day, paracetamol 1 g by mouth 4 times a day, NSAID of choice unless contra-indicated, metoclopramide 10 mg by mouth 3 times a day, and subcutaneous venous thromboembolism prophylaxis as per local protocol)
- As required: short-acting opiate and Buscopan for gastrointestinal/bladder spasm

Key Points

- Prolonged head-down position and pneumoperitoneum
- Limited patient access (**Fig. 3**)
- Avoid any patient movement during robotic instrumentation
- Sit up before extubation and demonstrate cuff leak

COMMON SURGICAL PROCEDURES AND IMPLICATIONS FOR THE ANESTHETIST

Radical Cystectomy (Robotic)

As for robot-assisted prostatectomy, except:

- Patient leveled to 15° for the ileal conduit or orthotopic neobladder (using a lower-midline (subumbilical) incision)
- Rectus sheath catheters for analgesia
- Seventy-two hours of oxycodone twice a day postoperatively for analgesia
- Increased duration of surgery
- Increased risk of complications of position and pneumoperitoneum

Radical Cystectomy (Open)

As mentioned for open procedures:

- Intraoperative cell salvage is used routinely

Fig. 3. Limited access to the patient for the anesthetist.

- Lower-midline (subumbilical) incision
- Rectus sheath catheters cover incisional pain (often placed under sterile conditions by anesthetist using ultrasonography, before surgical start); used for 5 days
- Opiates cover visceral pain for first 24 to 36 hours
- Blood transfusion can be required (usually in the postoperative days)
- Fluid management should be designed to maintain normovolemia and zero balance
- Complications secondary to pneumoperitoneum are no longer a concern

Mu receptor antagonists (eg, alvimopan) are used in some centers for open cystectomy. They have a limited ability to cross the blood-brain barrier so do not antagonize the analgesic effects of opioids but reduce peripheral effects such as ileus.

Radical Prostatectomy (Open)

- Lower-midline (subumbilical) incision
- Rectus sheath catheters (less visceral pain than cystectomy)
- Early food and fluids well tolerated
- Mobile within hours after surgery

Radical Nephrectomy

- Often completed using a laparoscopic approach, but requires a small incision at the end of the procedure to remove the kidney (surgical local anesthetic only required to port sites and wounds)
- Patient positioned laterally on the operating table
- Patient-controlled analgesia effective postoperatively
- If planned as an open procedure, consider epidural or wound-infiltration catheters

Partial Nephrectomy

- Usually completed via the laparoscopic approach (surgical local only)
- Patient positioned laterally on the operating table

SUMMARY OF ANESTHETIC MANAGEMENT

- There should be collaboration between the anesthesia or perioperative medicine team and the surgical team from the time a decision to operate is made. This collaboration ensures optimal management of comorbidities, shared decision making, and the management of risk.
- Early assessment of risk helps to determine the level of care patients receive postoperatively, which allows effective resource planning.
- Patients are less likely to need high-dependency care and blood transfusion than previously, when traditional approaches to major urologic surgery were used.
- The routine application of excellent standards of all aspects of anesthetic care applies to this specialist area.
- This operating environment is complex and differs from traditional practice in many ways. The anesthetic team need specific training and regular experience to make their best contributions to good patient outcomes.
- Specific scenarios (such as undocking) must be rehearsed to enable access to, and treatment of, patients in an emergency.
- Outcome and quality improvements can only be made if robust data are collected and regularly reviewed.

REFERENCES

1. NHS Enhanced Recovery Partnership. Enhanced recovery: consensus statement. NHS Improving Quality 2012/13.
2. Cerantola Y, Valerio M, Persson B, et al. Guidelines for perioperative care after radical cystectomy for bladder cancer: Enhanced Recovery After Surgery (ERAS) society recommendations. Clin Nutr 2013;32:879–87.
3. Dutton TJ, Daugherty MO, Mason RG, et al. Implementation of the Exeter enhanced recovery programme for patients undergoing radical cystectomy. BJU Int 2014;113(5):719–25.
4. Dutton TJ, McGrath JS, Daugherty MO. Use of rectus sheath catheters for pain relief in patients undergoing major pelvic urological surgery. BJU Int 2014;113(2):246–53.
5. O'Hara J. Anesthesia for select urologic procedures. ASA Refresher Courses in Anesthesiology 2011;39(1):115–9.
6. Gainsburg DM. Anesthetic concerns for robotic-assisted laparoscopic radical prostatectomy. Minerva Anestesiol 2012;78(5):596–604.
7. Phong SV, Koh LK. Anaesthesia for robotic-assisted radical prostatectomy: considerations for laparoscopy in the Trendelenburg position. Anaesth Intensive Care 2007;35:281–5.
8. Weber ED, Colyer MH, Lesser RL, et al. Posterior ischemic optic neuropathy after minimally invasive prostatectomy. J Neuroophthalmol 2007;27:285–7.
9. Awad H, Santilli S, Ohr M, et al. The effects of steep Trendelenburg positioning on intraocular pressure during robotic radical prostatectomy. Anesth Analg 2009; 109:473–8.
10. Kalmar AF, Foubert L, Hendricks JF, et al. Influence of steep Trendelenburg position and CO_2 pneumoperitoneum on cardiovascular, cerebrovascular, and respiratory homeostasis during robotic prostatectomy. Br J Anaesth 2010;104:433–9.
11. Hong JY, Kim WO, Kil HK. Detection of subclinical CO_2 embolism by transesophageal echocardiography during laparoscopic radical prostatectomy. Urology 2010;75:581–4.
12. Smith J, Pruthi RS, McGrath JS. Enhanced recovery programmes for patients undergoing radical cystectomy. Nat Rev Urol 2014;11:437–44.