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Review

Life in the laparoscopic fast lane: evidence-based perioperative management and enhanced recovery in benign gynaecological laparoscopy

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Key content
- Enhanced recovery after surgery (ERAS) protocols aim to shorten the length of hospital stay and expedite recovery, without increasing complications or readmission rates.
- Implementation of ERAS protocols should be evidence-based, including when applied to pre-admission clinic (including preoperative investigations), fasting, antibiotic prophylaxis, thromboprophylaxis, analgesia, expeditious removal of urinary catheters and early mobilisation.

Learning objectives
- To understand evidence-based perioperative management of patients undergoing laparoscopic procedures for benign gynaecological indications.
- To appraise critically the judicious ordering of preoperative investigations.
- To understand the importance of preoperatively assessing and managing each patient's risk of venous thromboembolism.
- To understand the key components of perioperative management that decrease surgical site infection(s).

Ethical issues
- Preoperative patient education is a vital component of perioperative management; written materials should be prepared in languages other than English to enable all patients to benefit from the ERAS approach.
- A balance must be found between applying ERAS protocols as a checklist to ensure all aspects of patient care have been considered and tailoring those protocols to each patient's individual needs.

Keywords: benign laparoscopy / enhanced recovery / evidence-based medicine / perioperative management / same-day surgery

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Introduction

Perioperative medicine encompasses the period between the moment surgery is contemplated and the patient's complete recovery. Enhanced recovery after surgery (ERAS) pathways standardise a variety of evidence-based perioperative inter ventions, ensuring patients are in prime condition for surgery (thereby minimising postponements and cancellations), receive optimal individualised and evidence-based care intraoperatively, and return to their normal lives as rapidly as possible. ERAS pathways focus on elements that may delay postoperative recovery, such as gut function, pain and immobility.

While initially developed for patients undergoing open colorectal surgery, there is mounting evidence that the ERAS approach is applicable to benign gynaecological laparoscopy.[1] The numerous, well-documented benefits of laparoscopy can be thwarted by nausea and vomiting, fluid overload, restricted ambulation, deconditioning and poorly controlled pain.[2] Applying evidence-based ERAS protocols to benign gynaecological laparoscopy reduces the incidence of such complications, thereby minimising the physiological effects of surgery.[3] Moreover, ERAS pathways increase patient satisfaction, decrease intravenous fluid admin istration, cost and morphine equivalents consumed, and expedite recovery, all without increasing complication or readmission rates.[4] Most patients undergoing gynaecological laparoscopy have short hospital stays (e.g. same-day discharge or overnight admission only). Implementing evidence-based ERAS pathways enables patients' length of stay to be measured in hours, rather than days.[5] One study found that implementation of an ERAS pathway following

laparoscopic hysterectomy decreased the average length of stay from 34 to 20 hours.[6]

This article provides a chronological outline of evidence-based perioperative management for benign gynaecological laparoscopy, from a patient's preoperative outpatient clinic appointment, to their postoperative recuperation.

Outpatient preoperative management

Gynaecology clinic

When an operation is booked, surgeons should specify the operation needed and which surgeon is best placed to perform that operation, and obtain patient consent. ERAS information should be conveyed in both verbal and written forms, encompassing perioperative expectations about patients' active involvement in their care.

When pertinent, clinicians should foreshadow how patients can improve their preoperative condition by ceasing smoking, optimising weight and managing their comorbidities (e.g. hypertension and diabetes).

Mounting evidence supports screening for and treating bacterial vaginosis (BV) prior to hysterectomy. These recommendations are based on the prevalence of BV, the efficacy and low cost of treatment and the link between BV and surgical site infections.[7] While such practice is not routine in the UK, the adoption of BV screening prior to hysterectomy is evidence-based and recommended.

The authors' international experience (in the USA and Australia) confirms the importance of a weekly multidisciplinary team (MDT) meeting, during which patients who have surgery booked in the coming month (and who have not yet been discussed in a previous MDT meeting) are reviewed. Discussion of patients at this MDT meeting should be on an 'opt out' basis; that is, all patients are reviewed, except well patients having minor surgery. Ideally, nonmedical personnel (e.g. pharmacy and nursing staff) should be involved because MDT discussions often pre-empt several perioperative challenges.

Pre-admission clinic

Gynaecological, anaesthetic and nursing staff should review relevant patients at a pre-admission clinic. Pre-admission clinics aspire to optimise patients' medical comorbidities and lifestyle factors. Such assessments have been shown to significantly lower cancellation rates.[8]

Behavioural modification

Patients can make several behavioural modifications to improve their perioperative outcomes. For example, patients should abstain from smoking tobacco or consuming alcohol for 4 weeks preoperatively.[2]

As obesity becomes more prevalent, greater numbers of increasingly obese women will undergo gynaecological laparoscopy. Resultant anaesthetic challenges include accurately measuring patients' blood pressure, obtaining intravenous access, achieving regional techniques and the potential for difficult airway management and ventilation.[9] In addition to anaesthetic and mobilisation issues, coexistent cardiac, respiratory and metabolic complications add to the perioperative challenges presented. An individualised risk–benefit analysis should be undertaken and nonoperative alternatives encouraged. Some hospitals have stringent policies (e.g. no elective surgery if body mass index, BMI, is greater than 35 kg/m^2); others require achievable weight loss (e.g. 5%) preoperatively.

Data from nongynaecological populations show that so-called 'prehabilitation' (i.e. preoperative exercise and physical conditioning) improves postoperative outcomes such as pain, length of stay, and physical function.[10]

Patient education and expectation management

One vital component of ERAS programmes is preoperative counselling, which sets realistic expectations regarding surgical and anaesthetic recovery and postoperative patient care.[2] Preoperative education reduces anxiety, increases patient satisfaction, reduces pain and nausea and improves patient wellbeing.[2] Some trusts have found that so-called 'recovery schools' are an efficient way to impart such knowledge. Here, classroom-based sessions outline the benefits of exercise, improved nutrition, the ERAS approach and preoperative lifestyle modifications (e.g. cessation of alcohol and smoking).

Management of venous thromboembolism and bleeding risk

Screen all patients for risk factors for both venous thromboembolism (VTE) and bleeding using the National Institute for Health and Care Excellence (NICE) risk assessment chart (provided as online supporting information).[11]

NICE simply states that pharmaceutical throm boprophylaxis (e.g. 7 days of low-molecular-weight heparin, LMWH) is warranted for patients 'whose risk of VTE outweighs their risk of bleeding'.[12] Hence, using this guideline means that surgeons must employ their clinical judgement and take individual patient factors into account.

Patients on estrogen-containing contraception or hormone replacement therapy should consider ceasing it 4 weeks preoperatively; offer advice on alternative contraception or management of vasomotor symptoms.[12]

An alternative VTE risk assessment tool is the Caprini score, as recommended by the American College of Chest Physicians. As outlined in Figure 1, this scoring system evaluates VTE risk based on patients' inherent predisposing factors (e.g. thrombophilias), modifiable risk factors (e.g. smoking status) and planned operation (e.g. open versus

1. Patient's age is:
☐ 0–40 years (**0 points**)
☐ 41–60 years (**1 point**)
☐ 61–74 years (**2 points**)
☐ 75 years or older (**3 points**)

2. Add **1 point** for each statement that applies:
☐ Surgery under general / regional anaesthesia that lasted more than 45 minutes in the last month
☐ Varicose veins (within the last month)
☐ Swollen legs (within the last month)
☐ Heart attack (within the last month)
☐ Serious infection (e.g. pneumonia, cellulitis) within the last month
☐ Inflammatory bowel disease (in the past / currently)
☐ Congestive heart failure (in the past / currently)
☐ Chronic lung disease (e.g. chronic obstructive pulmonary disease), NOT including asthma

3. For women only, add **1 point** for each statement that applies:
☐ Currently on hormonal contraception (pills, implants, patches, intrauterine device or injection) or hormonal replacement therapy
☐ Currently pregnant
☐ Had a baby within the last month
☐ History of unexplained stillbirth, more than three miscarriages, preterm birth with pre-eclampsia, or low birth weight baby

4. Add **2 points** for each statement that applies:
☐ Patient previously told that they have cancer, leukaemia, lymphoma, or melanoma
☐ In the last month, the patient has had a plaster cast or mold that has limited leg bending / walking normally
☐ In the last month, the patient has had a PICC line, port, or central venous access catheter inserted in their neck or chest

5. Add **3 points** for each statement that applies:
☐ Previous blood clot in legs, arms, abdomen or lungs
☐ Family history of blood clots
☐ Patient has previously been told they have increased risk of clotting based on blood tests

6. Please select the appropriate statement for the patient:
☐ In bed for less than 3 days when unable to walk more than 30 feet (add **1 point**)
☐ In bed for 3 days or more when unable to walk more than 30 feet (add **2 points**)

7. Add **5 points** for each of these statements that applies:
☐ Hip or knee replacement surgery within the last month
☐ Broken hip, pelvis or leg within the last month
☐ Serious trauma (e.g. multiple broken bones due to fall or car accident) within the last month
☐ Spinal cord injury resulting in paralysis within the last month
☐ Stroke (clot or haemorrhage in the brain, or transient ischaemic attack) within the last month

8. If the patient is scheduled for surgery, please select the most appropriate statement:
☐ Scheduled surgery is under general or regional anaesthesia and is expected to take less than 45 minutes (add **1 point**)
☐ Scheduled surgery is under general or regional anaesthesia and is expected to take more than 45 minutes, including laparoscopy (add **2 points)**

Total score:

Figure 1. Caprini score for venous thromboembolism risk stratification.[13]

laparoscopic surgery).[13] Of note, patients acquire one point when undertaking laparoscopic surgery of less than 45 minutes' duration, and two points if longer than 45 minutes' duration.

The patient's individualised Caprini score then allocates them to one of six VTE risk groups (from lowest to highest VTE risk). Thereafter, this guides their thromboprophylaxis, as noted in Table 1.[14] While this provides more detailed guidance than NICE and is less reliant on surgeons' clinical judgement, it does not take into account patients' bleeding risk.

If patients require LMWH postoperatively, yet are having an operation that carries a higher risk of intra-abdominal haemorrhage (e.g. myomectomy), management should be discussed with a haematologist. Surgery may need to be delayed to allow management of modifiable risk factors.

Patients with complex analgesic requirements

Patients with chronic pain syndromes, or who are dependent on controlled medications or illicit substances, require an individualised analgesic strategy devised in collaboration with a pain specialist.[15] Studies have found a 20.8–97.4% drop in

Table 1. Management of postoperative risk of venous thromboembolism based on patients' Caprini score

Caprini score	Risk category	VTE risk	Early frequent ambulation	Pneumatic compression devices	Graduated compression stockings	LWMH or low dose heparin	Duration
0	Lowest	Minimal	Indicated	Optional	Optional	Not necessary	During hospitalisation
1–2	Low	Minimal	Indicated	Indicated	Optional	Not necessary	During hospitalisation
3–4	Moderate	0.7%	Indicated	Indicated	Optional	Not necessary	During hospitalisation
5–6	High	1.8%	Indicated	Indicated	Indicated	Indicated	7–10 days in total
7–8	High	4.0%	Indicated	Indicated	Indicated	Indicated	7–10 days in total
≥9	Highest	10.7%	Indicated	Indicated	Indicated	Indicated	30 days in total

LMWH = low-molecular-weight heparin; VTE = venous thromboembolism

postoperative narcotic use when ERAS protocols are implemented.[3] Realistic expectations regarding postoperative pain should be outlined: clinicians should not promise a pain-free postoperative course; rather, that aggressive analgesia will lower pain to a tolerable level.

Patients with diabetes

One common comorbidity worth discussing is diabetes – see Box 1.

Preoperative investigations

Clinicians tend to order excessive tests preoperatively: only 0.0–2.8% of 'routine' tests influence patient management.[17] Only order tests that are clinically indicated; doing otherwise causes false positives, further delays and potential harm. Standardised guidelines for preoperative investigations should be used that are specific to the patient population and planned procedure.[18] Such guidelines should consider these key attributes:

- Diagnostic efficacy (whether the test correctly identifies abnormalities)
- Diagnostic effectiveness (whether the test changes the diagnosis)
- Therapeutic efficacy (whether the test changes patient management)
- Therapeutic effectiveness (whether the test changes patient outcomes).[19]

The more of these attributes a preoperative test has, the more worthwhile it is.

NICE guidance outlines that patients having 'intermediate' grade surgery (such as laparoscopy), with an American Society of Anesthesiologists (ASA) status of 1 or 2 should not routinely have a full blood count (FBC) taken preoperatively.[18] (Those with an ASA status of 3 or 4 plus cardiac, renal and/or diabetic comorbidities do warrant a preoperative FBC, however.) A 'blood group and save' is not warranted routinely prior to benign laparoscopy.

Patients with a history (or examination findings suggestive) of heavy menstrual bleeding warrant a preoperative serum haemoglobin test. Anaemia is an independent predictive risk factor for operative complications and death.[20] Serum haemoglobin (± C-reactive protein, CRP) should be tested at least 1 month preoperatively (in appropriate patients) to enable treatment, guided by the flowchart in Figure 2. If iron therapy is indicated, it can be given orally in divided daily doses; evaluate the response after 1 month of therapy. If oral iron is contraindicated, poorly tolerated or ineffective, consider intravenous iron infusion if rapid iron repletion is clinically important (e.g. less than 2 months until nondeferrable surgery).[21]

Preoperative electrocardiograms (ECGs) aim to detect underlying cardiac disease (e.g. arrhythmia or myocardial infarction) that will either alter anaesthetic plans and/or require the postponement of surgery. An ECG is rarely indicated prior to laparoscopy. NICE suggests that patients with an ASA of 1 do not need a preoperative ECG, those with an ASA of 2 do if they also have cardiovascular, renal, or diabetic comorbidities and those with an ASA of 3 or 4 do need an ECG.[18]

Chest radiography (CXR) is not recommended prior to surgery, unless the patient has a history of respiratory disease, or abnormal findings on respiratory examination. There is no age cut-off above which CXR is routine prior to benign laparoscopy.[18]

Alterations to regular medications

Sparse evidence is available to guide the management of patients' regular medications perioperatively. General principles include:

Box 1. Perioperative management for women with diabetes

The perioperative milieu challenges glycaemic management owing to fasting, counter-regulatory hormones released in response to the physiological stress of surgery and a slow return to normal diet. Hence, patients often require considerable modifications to their medications. Unfortunately, there is neither a strong evidence base, nor a generic recipe for doing so: management should be based on national and local guidelines and conducted in discussion with an endocrinologist.[16] The following need consideration:

- Patient's type of diabetes
- Planned surgery
- Presence or absence of diabetic complications
- Patient's preoperative HbA1c levels (see below)
- Withholding oral hypoglycaemic agents, which may need to be done for 24–48 hours preoperatively
- Alterations to insulin dosing[16]

Endeavour to achieve an HbA1c of less than 69 mmol/mol (less than 8.5%) preoperatively.[16] Patients with an HbA1c greater than 69 mmol/mol should be discussed with the diabetes team and, if it is safe to delay surgery, their HbA1c should be optimised. The perioperative risks of proceeding when HbA1c is suboptimal should be balanced against the urgency of the procedure.

On the day of surgery, patients with diabetes requiring medications should be first on a morning list so as to minimise the duration of fasting: management becomes more complex as the day progresses. Patients with insulin-controlled diabetes should not undertake carbohydrate loading preoperatively. Target preoperative capillary blood glucose is 6–10 mmol/L; up to 12 mmol/L may be acceptable.[16] Higher blood glucose levels require measurement of urinary or capillary blood ketones: if urinary ketones are greater than +++, or capillary blood ketones greater than 3 mmol/L, then surgery should be cancelled and the on-call diabetes team contacted. If ketones are below these levels, administer rapid-acting insulin and recheck the blood glucose 1 hour later. If surgery cannot be delayed, or if the response is inadequate, commence a variable rate intravenous insulin infusion ('sliding scale').[16]

Intraoperatively, the frequency of capillary blood glucose level monitoring is determined by clinical circumstances; blood sugar should be measured at least hourly.[16] Aim for a blood sugar level of 8 mmol/L (range 6–10 mmol/L; up to 12 mmol/L may be acceptable).[16]

Postoperatively, endeavour to maintain blood glucose levels between 6 and 10 mmol/L. Recommence oral hypoglycaemic agents once patients can eat and drink.

- To continue medications that will not impair the operation or anaesthesia, but will carry considerable risks if withdrawn (e.g. beta-blockers)
- To withhold medications that increase surgical or anaesthetic risk and are not essential for short-term quality of life (e.g. angiotensin inhibitors)
- If a medication doesn't clearly fit either category above: to base decisions on surgical and anaesthetic considerations, plus the stability of the condition the medication is used to treat[22]

When in doubt, discuss the medication in question with the prescribing clinician.

Perioperative management of antithrombotic agents (e.g. aspirin, clopidogrel, warfarin) presents contradictory risks: withholding these medications increases thrombotic risk, while continuation increases perioperative bleeding. At pre-admission clinic, discuss such patients with a haematologist and consult national and local guidelines.[23]

Goh et al.'s recent review of perioperative management of women on oral anticoagulants and antiplatelet agents undergoing gynaecological procedures provides invaluable guidance to clinicians.[24] Of note, the authors classify all day case and inpatient surgery as carrying a major bleeding risk. Their recommendations regarding perioperative management for such 'high bleeding risk' patients are summarised in Table 2.

Surgeons must assess the risk of postoperative haemorrhage on an individual case-by-case basis.

Immediately preoperative: day before and day of surgery

Patients should shower or bathe, using soap, on the day before or the day of surgery, to decrease the risk of surgical site infection.[25]

All patients admitted for abdominal or pelvic surgery should receive mechanical thromboprophylaxis: intermittent pneumatic compression devices, with/without graduated compression stockings. This should be continued until their mobility is no longer considerably reduced from baseline,[12] or as recommended based on their Caprini score (outlined previously).[14]

Bowel preparation and fasting

Mechanical bowel preparation (e.g. bisacodyl, sodium picosulfate) should not be routinely administered, even in patients with planned enteric resection (e.g. deeply invasive endometriosis with rectal involvement).[26] Data from several randomised controlled trials (RCTs) show that bowel preparation is not associated with improved intraoperative visualisation, bowel handling, or surgical ease and can cause patient distress and dehydration.[27]

Regarding fasting, mounting evidence supports solid food intake up to 6 hours preoperatively and clear fluids (in particular, a complex carbohydrate drink for patients without diabetes) up to 2 hours preoperatively.[2] These interventions reduce preoperative thirst, hunger and anxiety and

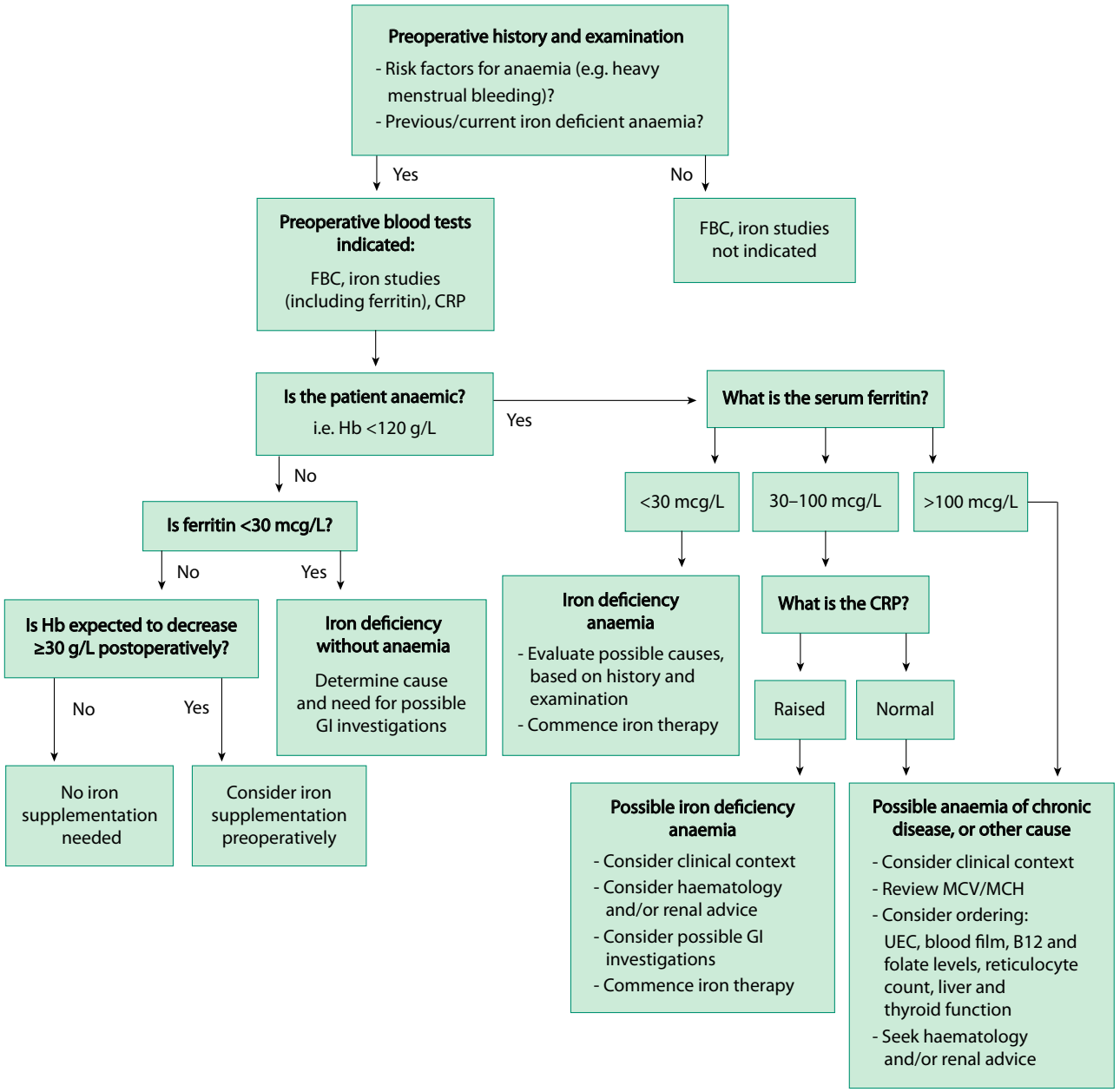

Figure 2. Algorithm to guide management of preoperative anaemia.[21] CRP = C-reactive protein; FBC = full blood count; GI = gastrointestinal; Hb = haemoglobin; MCH = mean corpuscular haemoglobin; MCV = mean corpuscular volume; UEC = urea, electrolytes and creatinine

postoperative insulin resistance, thereby improving both patient experience and length of stay.[28]

The neuroendocrine response to surgery results in sodium and water retention, leading to a reduction in maintenance fluid requirements.[29] Hence, administration of preoperative intravenous fluids for fasting patients is not routinely indicated.

Pregnancy testing

On the day of surgery, sensitively ask all women of childbearing potential (from menarche to 2 years after regular menses) whether there is any possibility they could be pregnant. Perform a urinary pregnancy test (with the woman's consent) if there is any doubt.[18] Such screening is positive in up to 0.4% of tests and fulfils the criteria outlined in the 'preoperative investigations' section.[30]

Preoperative analgesia

Preoperative analgesia improves postoperative pain levels, thereby decreasing postoperative opioid use. Administer the following oral analgesia to all laparoscopy patients, 1 hour

Table 2. Commonly used oral anticoagulants and antiplatelet agents and recommendations of perioperative management for laparoscopy.[24]

Class, examples	When should it be stopped preoperatively?	When should it be restarted postoperatively?
Vitamin K antagonist		
Warfarin	5 days prior to elective surgery, with INR check ideally the day before surgery (if INR >1.5 phytomednadione should be given) and on the day of surgery. Bridging with treatment dose LMWH should be considered in those with high VTE risk.	LMWH should not be given until 48 hours after surgery. Restart warfarin when bleeding risk is minimised. LMWH should be continued until INR in therapeutic range.
Factor Xa inhibitors		
Apixiban, rivaroxaban, edoxaban	Creatinine clearance ≥30 ml/min: stop 48 hours prior Creatinine clearance <30 ml/min: stop 72 hours prior	Wait 48 hours before re-introducing at the full dose. If high VTE risk, consider prophylactic dose of anticoagulation before restarting at full therapeutic dose.
Dabigatran	Creatinine clearance ≥80 ml/min: stop 48 hours prior Creatinine clearance ≥50 to <80 ml/min: stop 72 hours prior Creatinine clearance ≥30 ml/min to <50 ml/min: stop 96 hours prior	Wait 48 hours before re-introducing at the full dose. If high VTE risk, consider prophylactic dose of anticoagulation before restarting at full therapeutic dose.
COX inhibitor		
Aspirin	Continue	Continue
P2Y12 inhibitors		
Clopidogrel, prasugrel, ticagrelor	In patients with recent coronary syndrome or coronary artery stent on dual antiplatelet therapy: if possible, postpone the surgery; if not possible, stop medication 7 days before and continue with aspirin following liaison with haematologist.	Restart when haemostasis achieved (12–24 hours post-surgery).

INR = international normalised ratio; LMWH = low-molecular-weight heparin; VTE = venous thromboembolism

preoperatively (unless a contraindication exists): 1 g paracetamol, 400 mg celecoxib or ibuprofen, and 600 mg gabapentin.[2,26]

Intraoperative management

Preventing surgical site infections

Surgical site infections (SSIs) are infections that occur within 30 days of an operation, at or near a surgical incision. Two-thirds of gynaecological SSIs are superficial incisional infections (e.g. skin or subcutaneous tissues).[31]

Laparoscopic operations that are not contaminated by the genitourinary or digestive tracts do not require antimicrobial prophylaxis; such operations include oophorectomy, ovarian cystectomy, tubal ligation, salpingectomy, myomectomy (irrespective of whether the endometrial cavity is breached) and excision of endometriosis (except with bowel resection).[2,26] Conversely, operations that are expected to become 'clean-contaminated' warrant intravenous antibiotics.[26] ('Clean-contaminated' refers to procedures that open a colonised viscous or cavity under surgical circumstances, thereby allowing the ascent of pathogens.) Examples of 'clean-contaminated' procedures include total hysterectomy (which incises into the vagina) and excision of severe endometriosis (which may necessitate contact with vaginal, vesical, and/or bowel mucosa).

If indicated, prophylactic antibiotics should have a spectrum of activity covering the most common infecting organisms and be at adequate concentrations from the time of knife-to-skin until the operation's completion. One evidence-based regimen is to administer 2 g cefazolin or 1.5 g cefuroxime, plus 500 mg metronidazole (all intravenous) during the hour prior to skin incision (increase doses in patients with a BMI greater than 30 and/or weight greater than 100 kg).[26,32,33] Broadening coverage by administering metronidazole (rather than a cephalosporin alone) decreases SSI following hysterectomy.[33] Alternatively, similar broad-spectrum coverage is achieved with

intravenous amoxicillin plus a β-lactamase inhibitor (e.g. co-amoxiclav, at a dose of 2 g amoxicillin/1 g clavulanic acid).[2,25,30] For patients who are allergic to penicillins or cephalosporins, administer a combination of clindamycin and gentamicin, or a quinolone (e.g. ciprofloxacin).[26,32] Antibiotics should be repeated if the operative time is longer than 3 hours and/or blood loss is greater than 1500 ml.[32]

Regarding skin and vulval or vaginal preparation: traditionally, povidone-iodine was used in the vagina owing to concerns about complications attributable to alcohol-based chlorhexidine. However, compared with povidone-iodine, chlorhexidine more effectively eliminates vaginal bacteria and remains effective in the presence of blood.[31] In concentrations of 4% or less, alcohol-based chlorhexidine is well-tolerated vaginally and its use is supported by the American College of Obstetricians and Gynecologists.[26,34] Hence, surgeons should use alcohol-based chlorhexidine (less than or equal to 4% alcohol content) for abdominal, vulval and vaginal preparation.

Adoption of SSI reduction 'bundles' decreases the risk of SSI. Elements of such bundles (which are additive) include antibiotic prophylaxis, skin preparation, and avoidance of hypothermia, surgical drains, and perioperative hyperglycaemia.[2]

Intraoperative VTE prophylaxis

All patients undergoing laparoscopy should have graduated compression stockings and/or intermittent pneumatic compression intraoperatively.[12]

Maintenance of normothermia and euvolaemia

Heat loss is accelerated intraoperatively owing to abdominal exposure and preparation and impaired thermoregulatory responses secondary to general anaesthesia. Actively maintain normothermia using air blanket devices and warmed intravenous fluids.

Trendelenburg position and pneumoperitoneum reduce patients' cardiac output; hypovolaemia increases the risk of postoperative acute kidney injury, SSI, sepsis and prolonged hospital stay.[2] Hence, normovolaemia should be maintained, using stroke volume to guide intravenous fluid administration.

Intraoperative analgesia and wound closure

There are mixed data about the postoperative analgesic benefits of administering local anaesthetic to the tissue surrounding laparoscopic port sites. However, given the limited risks and low cost involved, most surgeons do so. One recommended regimen is to use 0.25% bupivacaine (2.5 mg/ml), to a maximum dose of 2.5 mg/kg.[35]

Skilled wound closure is pivotal to minimising wound complications. Subcuticular absorbable sutures are most often used for closing laparoscopic port sites, but so called 'tissue glue' can be used as an alternative.[36]

Postoperative: in the recovery bay and/or ward

Postoperative nausea and vomiting

Postoperative nausea and vomiting (PONV) affects 30% of all patients following general anaesthesia.[37] The Apfel score assesses four variables (female gender, history of motion sickness and/or PONV, non-smoker and planned opioid treatment postoperatively) and assigns one point for each variable. The probability of PONV for scores of 0, 1, 2, 3, and 4 are 10%, 21%, 39%, 61%, and 78%, respectively.[37] Most women undergoing benign gynaecological laparoscopy are in the highest risk group (i.e. at almost 80% risk of PONV).[37] Hence, PONV should be pre-empted in gynaecological laparoscopy patients and multifaceted management should be routinely implemented. This should include avoiding nitrous oxide and volatile anaesthetics where feasible, using a continuous target-controlled propofol infusion, utilising short-acting inhalational agents (e.g. sevoflurane or desflurane), minimising opioid use and using a lower neostigmine dose.[2] Routine prophylactic anti-emetics should be administered; a combination of two or more anti-emetic classes enhances potency (e.g. dexamethasone, plus aprepitant, ondansetron, midazolam or haloperidol).[2]

Diet and bowel function

Postoperatively, oral fluids and a regular ('full ward') diet can be commenced immediately.[26,38] This approach is safe and is associated with less nausea, shortened length of stay and higher patient satisfaction.[26]

Return to bowel-related functioning is an important factor indicating return to daily activities. Regular laxative use reduces the time to first defecation by 24 hours (from 69 to 45 hours).[39] Regular administration of laxatives is reasonable, given their favourable side-effect profile and low cost.

Postoperative analgesia

Mild pain is common following laparoscopy because carbon dioxide used to produce pneumoperitoneum can remain in situ, causing cramps, bloating and shoulder tip pain. These symptoms should subside within 24 hours, but if pain worsens thereafter, intra-abdominal complications must be excluded.[40]

Benefits of optimising analgesia include earlier mobilisation (decreasing VTE risk and pulmonary complications), improved sleep, higher patient satisfaction and fewer delayed discharges. Multimodal analgesia improves pain relief, while reducing the side-effects of individual agents. Administration of regular paracetamol and regular non-steroidal anti-inflammatory drugs reduces both pain and opioid consumption.[2] A weak opioid (e.g. codeine) can be added *pro re nata*.[40]

Opioids are associated with sedation, fatigue, restricted mobilisation, nausea and ileus, so minimising their use improves both the patient experience and functional recovery.[2] Evidence-based guidelines founded on patients' actual opioid use suggest that prescribing 15 x 5 mg oxycodone tablets after laparoscopic hysterectomy will meet or exceed 75% of patients' needs.[41] Prescribing any more than this may contribute to opioid dependence, which is a growing global problem.

Individual variability in patients' postoperative opioid consumption means that clinicians should consider patient factors such as preoperative opioid use and history of endometriosis.[42] Shared-decision making can further decrease opioid prescribing, without reducing patient satisfaction or postoperative pain control.[43]

Tapentadol (a relatively new medication) may become an alternative to oxycodone. Some studies have shown similar analgesic efficacy to oxycodone, with less nausea and constipation.[44] Further studies are needed to determine its role in post-laparoscopy analgesia.

Early mobilisation

Early mobilisation is key to ERAS: it counteracts the numerous disadvantges of bed rest, such as VTE and impaired insulin resistance, pulmonary function and tissue oxygenation.[28] Encourage mobilisation by prescribing effective multimodal analgesia, eschewing drain tubes and removing hindrances (e.g. catheters and intravenous cannulae) as soon as possible.

The pace of resumption of normal activities postoperatively depends on the operation performed. Pragmatic advice is, 'if it hurts, don't do it'; patients should notice a daily improvement in the activities they can undertake without pain.[40] Time until return to work depends on the patient's operation and occupation: 2 weeks of leave from a sedentary job after laparoscopy usually suffices. For 2 weeks postoperatively, patients should avoid lifting anything heavier than a full kettle and any considerable pushing and pulling activities (e.g. lawn-mowing, vacuuming).[40] Patients should not drive until they are no longer using opioids or other sedatives, have sufficient reaction times and can comfortably apply the brakes forcibly and check their blind spot.[40]

VTE prophylaxis

Patients should mobilise as soon as possible postoperatively. Additional thromboprophylaxis is guided by their individualised VTE risk assessment, as outlined previously.

If LMWH is indicated, then prior to administering the first dose, evaluate the likelihood of bleeding by reviewing the NICE bleeding risk assessment tool, operation notes, output from drain tubes (if present) and ooze on surgical dressings.[11]

Any tick in the 'bleeding risk' section of the NICE risk assessment tool should prompt clinicians to consider if the patient's higher risk of bleeding precludes LMWH administration.[11] If so, discuss the patient with their surgeon and a haematologist. Some situations may warrant unfractionated heparin, which can be quickly reversed with protamine.

If at low risk of bleeding, administer LMWH within 12 hours postoperatively.[45] Consider admitting patients overnight if they require LMWH; this allows for clinical observation (subtle signs of intra-abdominal haemorrhage may not be recognised at home until considerable morbidity occurs).

If patients fly within 1 month of their operation, it would be sensible for them to wear graduated compression stockings.[40]

Management of urinary catheters

Clinical guidelines regarding the management of urinary catheters after laparoscopy are sparse. Unless the patient has had a concomitant incontinence and/or prolapse procedure and/or has a history of urinary retention, their catheter should be removed at the end of their operation.

Regarding laparoscopic hysterectomy: guidelines from neither the UK nor USA provide recommendations on when to remove the urinary catheter.[46,47] An RCT of immediate versus delayed (18–24 hours postoperative) catheter removal following laparoscopic hysterectomy found that 4% of women in the immediate removal group had voiding dysfunction at 9 hours postoperatively.[48] The authors concluded that the clinical advantages of immediate catheter removal after uncomplicated laparoscopic hysterectomy outweigh the risk of urinary retention; this is consistent with an earlier RCT.[49]

Patients who have had a minor procedure (e.g. diagnostic laparoscopy, tubal ligation, ovarian cystectomy, excision of minimal/mild endometriosis), are at even lower risk of postoperative urinary retention (POUR). (POUR refers to impaired voiding after a procedure, despite a full bladder, which results in an elevated post-void residual, PVR.)[50] These patients do not even need to void prior to discharge, let alone undertake a formal 'trial of void'.

Women who have undergone concomitant incontinence and/or prolapse surgery and/or have a history of urinary retention, are at higher risk of POUR. These women do require a formal 'trial of void' prior to discharge. This involves asking the patient to void into a collection device when they have a strong urge, or after 4 hours have passed. The voided volume is measured, as is the PVR (by ultrasound). 'Success' is defined as the PVR being 100 ml or less, or the patient being able to void at least two-thirds of their total bladder volume (when total bladder volume = voided volume + PVR).[50] If a patient does not pass on

the first attempt, they can try again (when they have another strong urge or 4 hours later). If they do not pass on the second attempt, their trial of void is considered to be unsuccessful. They should be discharged with an indwelling catheter and the trial of void repeated 1 week later.

Postoperative investigations

Postoperative investigations are rarely indicated. When necessary, they should be guided by the patient's comorbidities and clinical state. An FBC is only warranted for patients who have symptoms and/or signs of haemodynamic compromise.[51]

Advice upon discharge

Discharge patients once they are mobilising, tolerating fluids and controlling their pain with oral analgesia. Although desirable, passing urine and flatus and tolerating oral intake are not prerequisites for discharge.[40] Prescribe a softening laxative (e.g. docusate) to take until their first bowel movement.

Patients should be advised when to seek clinical review; for example, if their abdominal pain worsens or if there is worsening distension; if they are unable to eat, drink, or mobilise; or if they experience nausea or vomiting, poor urine output or fever. Of note, almost all fevers that occur on day one are unexplained, with virtually all resolving by day four. Such febrile episodes are thought to be associated with direct tissue trauma and the resultant release of pyrogenic cytokines. Hence, a 'less is more' approach is generally appropriate. Conversely, fevers beginning three or more days after surgery often have an infectious aetiology and warrant investigation (e.g. physical examination, urinalysis, FBC, urine or blood culture, ultrasound and/or computed tomography) and broad-spectrum intravenous antibiotics (if infection is confirmed).[52]

Conclusion

Evidence-based perioperative management and ERAS should be the standard of care in gynaecological laparoscopy.[15] Such an approach has many benefits, including decreased cancellation rates, higher patient satisfaction, fewer complications and shorter length of stay. Despite the evidence base supporting an ERAS approach to gynaecological laparoscopy, diffusion and uptake of many interventions has been slow. Possible reasons include clinicians being unaware of, or unwilling to adopt, the interventions supported by evidence-based literature.

Simple measures that clinicians can implement include judicious ordering of preoperative investigations, screening for BV prior to laparoscopic hysterectomy, calculating each patient's VTE risk and implementing appropriate management thereafter, minimising preoperative fasting, only prescribing antibiotic prophylaxis and urinary 'trial of void' when indicated and prescribing multimodal analgesia. Such interventions will safely enhance patients' recovery and allow them to experience life in the laparoscopic fast lane.

Disclosure of interests

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Contribution to authorship

ABS initiated the idea, performed the literature search, and co-wrote the article. SAS, JL, and MW co-wrote the article. All authors approved the final version.

Supporting Information

Additional supporting information may be found in the online version of this article at http://wileyonlinelibrary.com/journal/tog

PDF S1. Risk assessment for venous thromboembolism.

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