Review Article

A narrative review of the role of anaesthesia and peri-operative medicine in improving outcomes after surgery for advanced ovarian cancer

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Objective: The broad aim of this review is to provide a summary of the challenges facing anaesthesia for this type of surgery, the strategies used to overcome these challenges, and how effective these approaches have proved to be.

Background: Advanced ovarian cancer surgery presents anaesthetists with the challenge of managing patients with potential multiple co-morbidities undergoing major open or extended laparoscopic surgeries. The disease has overall amongst the poorest overall survival rates of all malignancies, with an estimated 5-year survival rate of <43%, and the patients being of a generally older age group present specific challenges in terms of their accumulated co-morbidities.

Methods: To inform this review, we conducted a literature search using PubMed for relevant key words, supplemented by secondary searches based on the reference lists of retrieved papers. The literature review yielded discrete themes which we were able to organise under descriptions that form the subheadings in this review: pre-operative assessment and optimisation, intra-operative considerations, and postoperative care.

Conclusions: Despite the challenging nature of the underlying disease, optimal anaesthetic strategies tailored to the needs of the patient can help in improving recovery, and therefore potentially long-term outcome, after surgery for advanced ovarian carcinoma. Specifically there is room for patient autonomy in choices exercised especially with respect to pain relief. The review acknowledges surgical advances in the near future that may influence development of anaesthetic techniques.

Keywords: Anaesthesia; peri-operative medicine; pre-operative assessment; surgical outcomes

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Introduction

Ovarian cancer generally presents late, due to non-specific symptoms (1). Consequently, it has amongst the poorest overall survival rates of all gynaecological—and other—malignancies, with an estimated 5-year survival rate of 42.6% in the United Kingdom (2). Histological classification shows that malignancy arising from epithelial cells is the commonest form (90%), the remainder being germ cell, stromal or sex cord tumours (3). Surgical management forms the mainstay of both diagnosis and treatment in all tumour types (4).

Significant advances in the surgical management of advanced ovarian malignancy has meant that radical operative interventions can be offered to patients presenting at ever later stages in their disease process (5). Although this is a challenge for both surgery and anaesthesia, it also means that the benefits of even radical surgery and improvements to survival can be worthwhile.

The anaesthetist, as a member of the multi-disciplinary team, plays a pivotal role in providing care throughout the peri-operative period and in improving the long-term outcome after surgery. Additionally, due to the poor prognosis of advanced ovarian cancer, the anaesthetist may also be involved in the management of chronic pain and palliation where no operative intervention is possible. We present the following article in accordance with the Narrative Review reporting checklist (available at https://gpm.amegroups.com/article/view/10.21037/gpm-21-28/rc).

Methods

To inform this review, we conducted a literature search using PubMed for key words "anaesthesia", "ovarian cancer", "gynaecological oncology", "laparoscopic surgery" and their combinations. We confirmed our preliminary search to papers published within the last 10 years (i.e., 2010 onwards) so as to ensure a contemporaneous literature base, whilst recognising that some principles of anaesthetic management may have been established long before then. Since this was an expert-based or narrative review, we were open to considering publications of all types (including editorials and letters as well as clinical trials) but we excluded abstracts or short symposium presentations. The primary literature search was supplemented by secondary searches led by reference lists of the retrieved papers.

From review of the retrieved papers emerged specific themes, which we organise broadly as subheadings in this review which are: pre-operative assessment and optimisation, intra-operative considerations, and postoperative care. The broad aim of this review is to provide a summary of the challenges facing anaesthesia for this type of surgery, the strategies used to overcome these challenges, and how effective these approaches have proved to be.

Discussion

Pre-operative assessment and optimisation

Pre-operative assessment is now routine practice in all patients undergoing major surgery (6,7). This affords the opportunity for thorough investigation, planning of the treatment pathway, optimisation of the pre-surgical condition and time for patient counselling and education. Wherever possible, patients should be referred to meet members of the wider multidisciplinary team, including surgeons, anaesthetists, oncologists, stoma nurses and physiotherapists, prior to surgery. While the pre-operative anaesthetic assessment clinic facilitates discussion of anaesthetic options, care should be taken that this does not result in one anaesthetist dictating the specific management for another colleague.

Specific issues to be discussed include the description of regional anaesthesia (epidural or spinal injections) that are sited before induction of general anaesthesia. These reduce post-operative opiate use and side effects, especially a reduction in nausea and vomiting, and improved return of bowel function. Their use is a particular advantage in patients with impaired lung function (e.g., asthma, chronic airways disease) as opiates can depress postoperative ventilation and hypoxic drive (8,9). The use of epidural analgesia in ovarian cancer surgery is associated in some studies with improved overall survival (10) but the evidence base has not reached a level where this should be considered mandatory. Alternative techniques such as ultrasound-guided transversus abdominus plane (TAP) blocks (11) or surgically sited wound infusion catheters should be offered to patients in whom epidural analgesia is contraindicated, or those who decline the option.

Particular symptoms of relevance to anaesthesia, common in advanced ovarian cancer, include pleural effusions and malignant ascites. Both have potential to impair peri-operative ventilation. Ascites is usually managed by pre-operative drainage (12). While pleural effusions are also managed in this way, care needs to be taken that the 'pleural tap' does not then pose a later risk for (tension)

pneumothorax during the positive pressure ventilation of anaesthesia. A 'blind' needle insertion and drainage of pleural effusion on the day of surgery carries a high risk of this, but this is mitigated in two ways. First, to leave a chest drain or pigtail catheter *in situ* in the pleural space; or second (now more common) to employ ultrasound-guided drainage, usually conducted by interventional radiology, which has only a very low risk of subsequent pneumothorax (13).

The employment of invasive lines (arterial and central venous) which are required for radical surgeries should also be discussed, so that the patient is aware of the magnitude of surgery and associated risks.

Attendant co-morbidities may require immediate post-operative care in the high dependency (HDU) or intensive care unit (ICU). There are no explicit rules, but the judgement is based on, amongst other things, the extent of planned surgery (including the degree of anticipated blood loss) and pre-existing co-morbidities (where severe cardiac and pulmonary disease makes HDU or ICU care more likely; and renal disease requiring early dialysis or haemofiltration is also best managed in an HDU or ICU setting) (14).

It is also now common to use pre-operative exercise testing to help assess the need for elective HDU or ICU admission (15,16). In patients who are physically able to undertake the investigation, cardiopulmonary exercise testing (CPET) aids in the objective identification of patients at high risk of perioperative morbidity. An anaerobic threshold (AT) of <11 $mL \cdot min^{-1} \cdot kg^{-1}$ is a commonly recognised endpoint used to identify patients at high risk of complications after major surgery, although alternative endpoints within the exercise response may better indicate a patient's ability to cope with perioperative metabolic demands (17).

There has been increasing attention to the pre-operative management of anaemia, a common symptom in advanced ovarian malignancy. Anaemia is associated with adverse perioperative outcomes including the need for blood transfusion and increased length of hospital stay (LOS) (18), as well as reduced survival in patients with ovarian cancer (19). Iron deficiency, either absolute due to poor nutritional intake or blood loss; or the functional iron deficiency caused by impaired iron absorption in anaemia of chronic disease (20), is the most common cause (21). Pre-operative iron replacement has previously been advocated (22), however, recent evidence (23) has failed to show a reduction in the frequency of intraoperative blood transfusion, postoperative complications or mortality through the use of intravenous iron replacement in anaemic patients prior to major elective abdominal surgery.

Neoadjuvant chemotherapy prior to surgical intervention is increasingly used in ovarian cancer (24), and platinum-based agents such as cisplatin and carboplatin have a range of side-effects of which the anaesthetist should be aware. These include immunosuppression, and toxic effects on the pulmonary, cardiac, renal and hepatic systems, that should be detected by the electrocardiogram (ECG), baseline echocardiography and blood tests that are routine in the pre-assessment clinic.

Because of the later age group in which ovarian cancer usually presents, patients may have multiple unrelated co-morbidities and advice regarding pre-operative continuation and cessation of certain medications is important. Drugs generally continued include cardioactive, hypertensive and psychiatric medications. Drugs generally omitted include oral contraceptive agents, antiplatelets, anticoagulants and diabetic medications, each carrying specific advice as to how many doses to omit pre-operatively.

Prehabilitation aims to aid the response to surgery and postoperative recovery by improving functional and metabolic reserves prior to the surgical procedure. It forms a cornerstone of enhanced recovery programs, which are increasingly recommended in the management of gynaecological malignancy (25,26). Although it may not be feasible to allow for prolonged prehabilitation in the perioperative interval, interventions such as nutritional counselling and support, exercise prescription (27) and certain psychological interventions (e.g., counselling and stress reduction techniques) are achievable in the short term. Smoking cessation and reduction of alcohol intake should be encouraged and comorbidities such as diabetes and hypertension should be identified and treated. Enhanced recovery protocols are discussed further below.

Intra-operative considerations

The common types of surgery include salpingo-oophorectomy, hysterectomy, lymphadenectomy, peritonectomy, omentectomy and surgical debulking of the tumour. The aim is to remove the bulk of the tumour, after which platinum-based chemotherapy is usually offered (5). More recently, neoadjuvant chemotherapy has been used pre-operatively in selected patients to reduce tumour bulk (24). Additionally, hyperthermic chemotherapy may be delivered to the peritoneal cavity directly after cytoreductive surgery. Radiotherapy is rarely used in the

management of ovarian cancer, apart from the treatment of metastases. Radical surgery may also involve the need to operate on or near major arteries and veins (e.g., iliacs), bladder and ureters, and rarely, liver or spleen where there are metastases. Some surgeons favour stripping the diaphragmatic surface of any metastatic deposits, which may include entering the chest cavity.

The entire operation can now be performed laparoscopically, where access permits. Surgery duration is long: rarely less than 5 hours and often much longer. This has important implications for planning and scheduling (28) of surgical lists since undertaking more than one such case in most block-scheduling allocations of 8 or even 10 hours is difficult (29,30).

The open and laparoscopic approaches present their own respective challenges for anaesthesia. Open surgery requires particular attention to post-operative analgesia (regional anaesthesia is discussed above) and post-operative intravenous patient-controlled analgesia (opiate PCA) or patient-controlled epidural analgesia (PCEA) are commonplace. The laparoscopic approach requires attention to intra-operative patient positioning, usually in the steep head-down, Trendelenburg position. Specific concerns for the anaesthetist include impaired pulmonary function and potential for reduced ventilation (which can in turn require high inflation pressures), airway and facial oedema, increased intraocular and intracranial pressure and the risk of nerve injury (31).

A further facet of the ergonomics of the Trendelenburg position is that the gynaecologists are often standing by or close to the head of the patient, looking down into the pelvis with the laparoscope, a standing position akin to head and neck surgery. The anaesthetist therefore needs to plan the layout of the operating room and anaesthesia machine accordingly. Due to the prolonged duration of surgery, careful attention to positioning and alleviation of pressure areas is imperative. Repositioning at various intervals may be required in prolonged cases, especially in those at high risk of pressure injury, including frail or obese patients (32).

Obesity is a risk factor in ovarian malignancy (33,34) and will add to the challenges of laparoscopic surgery, pneumoperitoneum and head-down positioning (35). Obese patients are more likely to have larger tumours and disseminated disease at time of diagnosis compared to non-obese patients (36,37), making surgery and anaesthesia more high risk and technically challenging.

Regardless of approach, general anaesthesia with tracheal intubation and mechanical ventilation is universal. One point of debate has been whether total intravenous anaesthesia (TIVA) offers better outcomes such as smoother recovery, but also in particular some protection from cancer recurrence. This debate is based on retrospective analysis and basic science studies suggesting that propofol has specific inhibitory effects on cancer versus normal cells. However, this has not been borne out by recent prospective randomised controlled trials (38-40). With recent discoveries that volatile anaesthetics each act in their own specific way (41-43), with sevoflurane in particular being less depressive of hypoxic chemoreflexes and ventilation (44-46) and thus affording rapid recovery, there is probably no significant difference between TIVA- and volatile-based techniques.

A related debate is the use of intravenous lidocaine infusion: local anaesthetic, both as regional anaesthesia and intravenous infusion, has been suggested to reduce cancer recurrence (47,48). Again, clinical trials are not supportive (38) and this potential advantage appears to have been outweighed by the serious, life-threatening risks posed by intravenous lidocaine therapy (49).

Large fluid shifts with the potential for haemodynamic instability should be anticipated. Due to the radical nature of surgery extensive blood loss may occur. Additionally, in patients with large volume ascites, rapid drainage of ascitic fluid when opening the abdomen can result in sudden haemodynamic decompensation. The insertion of a minimum of two large bore intravenous canulae at the time of induction, along with arterial cannulation and invasive haemodynamic monitoring is recommended. Some patients may require intra-operative vasopressor support to maintain adequate perfusion, and central venous cannulation should therefore be considered. Appropriate blood products should be easily accessible, with blood loss replacement according to best practice guidelines. Blood loss may be greater in patients undergoing surgery after chemotherapy or previous interval debulking due to the presence of adhesions and fibrosis. Estimation of blood loss may be difficult due to dilution with ascites and irrigation fluid. Urinary catheterisation is necessary for both the surgery and for hourly urine output monitoring. In patients without pre-existing renal disease, urine output of >0.5 $mL \cdot kg^{-1} \cdot h^{-1}$ is expected (50).

Arterial blood gas analysis should be performed at regular intervals for both gas exchange and glucose parameters. Metabolic derangements due to fluid shifts, blood product use and pre-existing conditions or medications are common and should be corrected.

Perioperative hyperglycaemia is an independent marker of poor surgical outcomes including delayed wound healing, surgical site infection, acute kidney injury, prolonged hospital stay and increased postoperative mortality in both diabetic and non-diabetic populations (51,52). The maintenance of intraoperative glucose levels between 6–10 mmol·L^{-1} through the use of subcutaneous or intravenous insulin is recommended, with regular monitoring of glucose levels in order to minimize the risk of hypoglycaemia (53,54).

Patients with malignancy undergoing major surgery have an increased propensity to develop venous thrombo-embolism (55). Perioperative mechanical and chemical thromboprophylaxis according to local guidelines must be considered. Post-operatively, early ambulation should be encouraged.

Postoperative care

The requirement for post-operative HDU or ICU admission is discussed above. Regardless, as after all major surgeries, careful postoperative care is necessary. Specific attention is needed for, amongst other things: analgesia, haemodynamic stability including anaemia, renal output and fluid balance, bowel function and management of post-operative pain, nausea and vomiting.

Enhanced recovery after surgery (ERAS) is a multimodal approach to improve the functional rehabilitation of patients after surgery. Recent evidence has demonstrated the value of ERAS in patients undergoing major advanced ovarian cancer surgery (56). The PROFAST trial (57) demonstrated a reduction in the LOS without increasing complication or readmission rates.

ERAS protocols in cancer surgery involve several facets. In the interval between diagnosis and surgery, the patient undergoes multidisciplinary workup including counselling and prehabilitation (discussed above). On the day of surgery, fasting times are limited, with solid food allowed up to 6 hours, and clear fluid up to 2 hours, prior to surgery. Carbohydrate loading in the form of supplemental drinks is offered and the use of bowel preparation is avoided. Intra-operatively, a standardized anaesthetic approach is employed, with focus on strategies to avoid post-operative nausea, vomiting, pain and cardiorespiratory complications. The use of tubes and catheters is limited to as short a duration as possible. In the post-operative period, early mobilisation and resumption of oral intake is encouraged. Post-operative pain is managed using opiate-sparing strategies to limit risks such as post-operative ileus and nausea and vomiting. Successful implementation of ERAS protocols requires an engaged multidisciplinary team.

Due to the high risk of venous thrombo-embolism, mechanical and chemical thromboprophylaxis are recommended and early ambulation should be encouraged.

Atelectasis and associated pulmonary complications are common following major abdominal surgery, especially those involving high dissection in the upper abdomen. Deep breathing, coughing and mobilisation should be encouraged. Patients with coexisting cardiorespiratory disease are at increased risk of developing postoperative complications such as myocardial ischaemia, arrhythmias, pneumonia and pulmonary oedema. If diaphragmatic stripping has been undertaken, specific care should be taken to exclude signs of pneumothorax.

The development of chronic pain and altered sensation is well recognised after major gynaecological surgery. Careful management of early postoperative pain may reduce this risk. In the long term, the anaesthetist and other chronic pain physicians play a role in the management of chronic post-surgical pain.

Prior to discharge from hospital, patients should receive counselling regarding the resumption of normal activity such as work and sexual function (58,59). A low mood is common after major gynaecological surgery, both due to fatigue and hormonal changes.

Conclusions

The anaesthetist plays an important role in improving recovery, and therefore potentially long-term outcome, after surgery for advanced ovarian carcinoma (*Table 1*). The approach is not a 'one size fits all' but an opportunity to tailor technique to the patient's co-morbidities and risk factors throughout the perioperative journey. In this way patient preferences can be factored in, and patient satisfaction, especially with regard to pain relief, is a priority. Possible surgical advances that may influence future anaesthetic technique include the use of robotics (60), lasers or photodynamic therapies (61), each of which may require novel amendments to anaesthetic strategy.

Table 1 Summary of key points from this review, for each of the phases of anaesthesia/peri-operative care

Phase of anaesthesia	Key points of review
Pre-operative assessment and optimisation	• Multidisciplinary involvement before surgery
	• Discuss options for analgesia
	• Optimise any co-morbidities
	• Screen for pleural effusion and ascites
	• Manage anaemia if present
	• Discuss risks (including need for invasive lines, HDU, ICU)
	• Consider prehablitation
Intra-operative considerations	• Plan and schedule theatre lists to take account of operation time
	• Lung ventilation strategies for laparoscopic surgery
	• Consider TIVA
	• Consider intravenous lidocaine if no other blocks, epidural or infiltration employed
	• Careful monitoring of blood indices during prolonged surgery
Postoperative care	• Elective HDU or ICU admission for some patients, sometimes requiring prolonged lung ventilation
	• ERAS pathway for some patients
	• Continued analgesia, anti-thromboembolic and physiotherapy care
	• Psychological counselling may be needed

HDU, high dependency unit; ICU, intensive care unit; TIVA, total intravenous anaesthesia; ERAS, enhanced recovery after surgery.

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Footnote

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References

1. Ebell MH, Culp MB, Radke TJ. A systematic review of symptoms for the diagnosis of ovarian cancer. Am J Prev

Med 2016;50:384-94.
2. Office for National Statistics. Cancer Survival in England: adult, stage at diagnosis and childhood – patients followed up to 2018 [Internet]. [Release date 2019 August 12; cited 2021 Mar 1]. Available from: https://www.ons.gov.uk/peoplepopulationandcommunity/healthandsocialcare/conditionsanddiseases/bulletins/cancersurvivalinengland/stageatdiagnosisandchildhoodpatientsfollowedupto2018
3. Roett MA, Evans P. Ovarian cancer: an overview. Am Fam Physician 2009;80:609-16.
4. Jayson GC, Kohn EC, Kitchener HC, et al. Ovarian cancer. Lancet 2014;384:1376-88.
5. Hacker NF, Rao A. Surgery for advanced epithelial ovarian cancer. Best Pract Res Clin Obstet Gynaecol 2017;41:71-87.
6. Rai MR, Pandit JJ. Day of surgery cancellations after nurse-led pre-assessment in an elective surgical centre: the first 2 years. Anaesthesia 2003;58:692-9.
7. Pandit JJ. Practical Operating Theatre Management. Measuring and Improving Performance and Patient Experience. 1st edn. Cambridge University Press; 2019.
8. Raju M, Pandit JJ. Re-awakening the carotid bodies after anaesthesia: managing hypnotic and neuromuscular blocking agents. Anaesthesia 2020;75:301-4.
9. Pandit JJ, Eriksson LI. Reversing neuromuscular blockade: not just the diaphragm, but carotid body function too. Anesthesiology 2019;131:453-5.
10. Tseng JH, Cowan RA, Afonso AM, et al. Perioperative epidural use and survival outcomes in patients undergoing primary debulking surgery for advanced ovarian cancer. Gynecol Oncol 2018;151:287-93.
11. Rashid A, Gorissen KJ, Ris F, et al. No benefit of ultrasound-guided transversus abdominis plane blocks over wound infiltration with local anaesthetic in elective laparoscopic colonic surgery: results of a double-blind randomized controlled trial. Colorectal Dis 2017;19:681-9.
12. Kietpeerakool C, Rattanakanokchai S, Jampathong N, et al. Management of drainage for malignant ascites in gynaecological cancer. Cochrane Database Syst Rev 2019;12:CD007794.
13. Gordon CE, Feller-Kopman D, Balk EM, et al. Pneumothorax following thoracentesis: a systematic review and meta-analysis. Arch Intern Med 2010;170:332-9.
14. Gillies MA, Pearse RM. Intensive care after high-risk surgery: what's in a name? Anesthesiology 2016;124:761-2.
15. Levett DZ, Grocott MP. Cardiopulmonary exercise testing for risk prediction in major abdominal surgery. Anesthesiol Clin 2015;33:1-16.
16. American Thoracic Society; American College of Chest Physicians. ATS/ACCP Statement on cardiopulmonary exercise testing. Am J Respir Crit Care Med 2003;167:211-77.
17. Hopker JG, Jobson SA, Pandit JJ. Controversies in the physiological basis of the 'anaerobic threshold' and their implications for clinical cardiopulmonary exercise testing. Anaesthesia 2011;66:111-23.
18. Musallam KM, Tamim HM, Richards T, et al. Preoperative anaemia and postoperative outcomes in non-cardiac surgery: a retrospective cohort study. Lancet 2011;378:1396-407.
19. Caro JJ, Salas M, Ward A, et al. Anemia as an independent prognostic factor for survival in patients with cancer: a systemic, quantitative review. Cancer 2001;91:2214-21.
20. Weiss G, Goodnough LT. Anemia of chronic disease. N Engl J Med 2005;352:1011-23.
21. Birgegård G, Aapro MS, Bokemeyer C, et al. Cancer-related anemia: pathogenesis, prevalence and treatment. Oncology 2005;68 Suppl 1:3-11.
22. Muñoz M, Acheson AG, Auerbach M, et al. International consensus statement on the peri-operative management of anaemia and iron deficiency. Anaesthesia 2017;72:233-47.
23. Richards T, Baikady RR, Clevenger B, et al. Preoperative intravenous iron to treat anaemia before major abdominal surgery (PREVENTT): a randomised, double-blind, controlled trial. Lancet 2020. [Epub ahead of print]. doi: 10.1016/S0140-6736(20)31539-7.
24. Elies A, Rivière S, Pouget N, et al. The role of neoadjuvant chemotherapy in ovarian cancer. Expert Rev Anticancer Ther 2018;18:555-66.
25. Miralpeix E, Mancebo G, Gayete S, et al. Role and impact of multimodal prehabilitation for gynecologic oncology patients in an Enhanced Recovery After Surgery (ERAS) program. Int J Gynecol Cancer 2019;29:1235-43.
26. Schneider S, Armbrust R, Spies C, et al. Prehabilitation programs and ERAS protocols in gynecological oncology: a comprehensive review. Arch Gynecol Obstet 2020;301:315-26.
27. Steffens D, Young J, Beckenkamp PR, et al. Feasibility and acceptability of PrE-operative Physical Activity to improve patient outcomes After major cancer surgery: study protocol for a pilot randomised controlled trial (PEPA Trial). Trials 2018;19:112.
28. Pandit JJ, Tavare A. Using mean duration and variation of procedure times to plan a list of surgical operations

to fit into the scheduled list time. Eur J Anaesthesiol 2011;28:493-501.
29. Pandit JJ, Westbury S, Pandit M. The concept of surgical operating list 'efficiency': a formula to describe the term. Anaesthesia 2007;62:895-903.
30. Pandit JJ, Dexter F. Lack of sensitivity of staffing for 8-hour sessions to standard deviation in daily actual hours of operating room time used for surgeons with long queues. Anesth Analg 2009;108:1910-5.
31. Arvizo C, Mehta ST, Yunker A. Adverse events related to Trendelenburg position during laparoscopic surgery: recommendations and review of the literature. Curr Opin Obstet Gynecol 2018;30:272-8.
32. Souki FG, Rodriguez-Blanco YF, Polu SR, et al. Survey of anesthesiologists' practices related to steep Trendelenburg positioning in the USA. BMC Anesthesiol 2018;18:117.
33. Bae HS, Kim HJ, Hong JH, et al. Obesity and epithelial ovarian cancer survival: a systematic review and meta-analysis. J Ovarian Res 2014;7:41.
34. Foong KW, Bolton H. Obesity and ovarian cancer risk: A systematic review. Post Reprod Health 2017;23:183-98.
35. Rouby JJ, Monsel A, Lucidarme O, et al. Trendelenburg position and morbid obesity: a respiratory challenge for the anesthesiologist. Anesthesiology 2019;131:10-3.
36. Tworoger SS, Huang T. Obesity and ovarian cancer. Recent Results Cancer Res 2016;208:155-76.
37. Wolfberg AJ, Montz FJ, Bristow RE. Role of obesity in the surgical management of advanced-stage ovarian cancer. J Reprod Med 2004;49:473-6.
38. Cata JP, Guerra C, Soto G, et al. Anesthesia options and the recurrence of cancer: what we know so far? Local Reg Anesth 2020;13:57-72.
39. Hong B, Lee S, Kim Y, et al. Anesthetics and long-term survival after cancer surgery-total intravenous versus volatile anesthesia: a retrospective study. BMC Anesthesiol 2019;19:233.
40. Edwards ZE, Kelliher LJS. Propofol-TIVA versus inhalational anesthesia for cancer surgery. Dig Med Res 2020;3:15.
41. Pandit JJ. Monitoring (un)consciousness: the implications of a new definition of 'anaesthesia'. Anaesthesia 2014;69:801-7.
42. Pandit JJ. The variable effect of low-dose volatile anaesthetics on the acute ventilatory response to hypoxia in humans: a quantitative review. Anaesthesia 2002;57:632-43.
43. Pandit JJ, Huskens N, O'Donohoe PB, et al. Competitive interactions between halothane and isoflurane at the carotid body and TASK channels. Anesthesiology 2020;133:1046-59.
44. Pandit JJ, Manning-Fox J, Dorrington KL, et al. Effects of subanaesthetic sevoflurane on ventilation. 1: Response to acute and sustained hypercapnia in humans. Br J Anaesth 1999;83:204-9.
45. Pandit JJ, Manning-Fox J, Dorrington KL, et al. Effects of subanaesthetic sevoflurane on ventilation. 2: Response to acute and sustained hypoxia in humans. Br J Anaesth 1999;83:210-6.
46. Pandit JJ, Buckler KJ. Differential effects of halothane and sevoflurane on hypoxia-induced intracellular calcium transients of neonatal rat carotid body type I cells. Br J Anaesth 2009;103:701-10.
47. Soto G, Naranjo González M, Calero F. Intravenous lidocaine infusion. Rev Esp Anestesiol Reanim (Engl Ed) 2018;65:269-74.
48. Chamaraux-Tran TN, Piegeler T. The amide local anesthetic lidocaine in cancer surgery-potential antimetastatic effects and preservation of immune cell function? A narrative review. Front Med (Lausanne) 2017;4:235.
49. Pandit JJ, McGuire N. Unlicensed intravenous lidocaine for postoperative pain: always a safer 'licence to stop' than to start. Anaesthesia 2021;76:156-60.
50. O'Connor ME, Kirwan CJ, Pearse RM, et al. Incidence and associations of acute kidney injury after major abdominal surgery. Intensive Care Med 2016;42:521-30.
51. Kotagal M, Symons RG, Hirsch IB, et al. Perioperative hyperglycemia and risk of adverse events among patients with and without diabetes. Ann Surg 2015;261:97-103.
52. Kang ZQ, Huo JL, Zhai XJ. Effects of perioperative tight glycemic control on postoperative outcomes: a meta-analysis. Endocr Connect 2018;7:R316-27.
53. Vogt AP, Bally L. Perioperative glucose management: Current status and future directions. Best Pract Res Clin Anaesthesiol 2020;34:213-24.
54. Stubbs DJ, Levy N, Dhatariya K. The rationale and the strategies to achieve perioperative glycaemic control. BJA Educ 2017;17:185-93.
55. Cohen A, Lim CS, Davies AH. Venous thromboembolism in gynecological malignancy. Int J Gynecol Cancer 2017;27:1970-8.
56. Nelson G, Bakkum-Gamez J, Kalogera E, et al. Guidelines for perioperative care in gynecologic/oncology: Enhanced Recovery After Surgery (ERAS) Society recommendations-2019 update. Int J Gynecol Cancer 2019;29:651-68.

57. Sánchez-Iglesias JL, Carbonell-Socias M, Pérez-Benavente MA, et al. PROFAST: A randomised trial implementing enhanced recovery after surgery for highcomplexity advanced ovarian cancer surgery. Eur J Cancer 2020;136:149-58.
58. Logue CA, Pugh J, Jayson G. Psychosexual morbidity in women with ovarian cancer. Int J Gynecol Cancer 2020;30:1983-9.
59. Bogani G, Ditto A, Pinelli C, et al. Ten-year follow-up study of long-term outcomes after conservative surgery for early-stage ovarian cancer. Int J Gynaecol Obstet 2020;150:169-76.
60. Minig L, Padilla Iserte P, Zorrero C, et al. Robotic surgery in women with ovarian cancer: surgical technique and evidence of clinical outcomes. J Minim Invasive Gynecol 2016;23:309-16.
61. Bilyalov AI, Shanazarov NA, Zinchenko SV. Photodynamic therapy as alternative method of treatment of metastatic ovarian cancer with many recurrence: case report. Bio Nano Sci 2020;10:807-10.

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