Gynecologic oncology has seen a tremendous growth as a surgical specialty over the past four decades. However, many regions of the world still lack structured training programs in this discipline. The aim of this article is to identify the essential skills for a gynecologic oncologist to be able to provide optimal care to women diagnosed with gynecologic cancer. Where the evidence exists in the literature we identify the learning curve necessary. Identifying essential skills required for the practice of gynecologic oncology should assist in standardizing care provision globally, and could be a starting point for health systems beginning structured training programs. Development of surgical skills requires adequate training, mentorship, and self-evaluation as an ongoing process beyond the years spent in training programs.

**KEYWORDS**
FIGO Cancer Report; Gynecologic oncology; Surgical skills; Surgical training
in a high-volume center. These include procedures that involve allied surgical specialties such as urological, colorectal, plastic, and upper gastrointestinal surgery. Some of these desirable skills currently lack levels of evidence, but will impact on patient care and quality of care in years to come. A gynecologic oncologist should learn these skills during training and may require help from specialty colleagues during the initial learning curve.

Optional skills are those that currently do not have level 1 evidence and are performed in a research context but are likely to be accepted as standard practice. Optional skills are associated primarily with new technologies that may become part of standard care in the future and are therefore not discussed in detail in this article.

Depending on the resource setting of individual centers and region of the world, some of the procedures mentioned in the "desirable" category might be routine procedures in daily practice.

In our review, we have tried to identify the learning curve for individual procedures where possible. Given that the concept of a learning curve has only been used in the context of newer technologies, beginning with laparoscopy, this information is lacking for most of the "traditional" procedures in gynecologic oncology.

2 | TRAINING IN GYNECOLOGIC ONCOLOGY

Most regions offering structured training programs in gynecologic oncology define the scope of surgical procedures that trainees are expected to gain experience in during fellowship training. These procedures can broadly be grouped into gynecologic procedures and extended scope surgical procedures that may include general surgical, plastic, colorectal, and urological procedures. We refer to extended scope surgical procedures as "general surgical procedures" in this article. Most structured training programs do not stipulate a minimum number of procedures required for accreditation as a gynecologic oncologist; instead, the emphasis is on the overall volume of surgical exposure and some form of assessment process during training. Regions with structured training programs have identified a need for exposure to extended scope surgical procedures. This is largely related to extended cytoreductive procedures in surgical management of ovarian cancer. Trainee surveys have identified the inability of some training programs to provide adequate experience in general surgical procedures. The standardized training curriculum recommended by the European Society of Gynaecological Oncology (ESGO) has set a minimum number of surgical procedures directly related to gynecologic cancer diagnosis. The minimum training standards for the type and number of extended surgical procedures is difficult to standardize given the variation in surgical management of ovarian cancer across various centers, even in high-income countries. Some common themes can be identified based on a review of the curriculums from various structured training programs. Most of these programs have identified a need for additional training in extended surgical procedures, including small and large bowel surgery, urological procedures, plastic surgery, diaphragmatic surgery, and splenectomy.

3 | SURGICAL SKILLS

3.1 | Radical hysterectomy

Any discourse on surgical skills in gynecological oncology must start with radical hysterectomy for cervical cancer (Fig. 1). Radical hysterectomy and pelvic lymph node dissection are the only surgical procedures in gynecologic oncology that have been described in terms of pelvic anatomic landmarks, with the aim to standardize and define the completeness of the surgical outcome. The Piver-Rutledge-Smith classification described in 1974 stood the test of time until 2008 when the Querleu and Morrow classification (Q-M classification, Table 1) based on more specific anatomic landmarks attempted to standardize the description of surgery. Cibula et al. attempted to further refine the description of the Q-M classification with emphasis on a three-dimensional description of the parametrium. We recommend that gynecologic oncology training programs provide adequate training in at least type B and type C1 radical hysterectomy, as described in the Q-M classification. The ability to perform a type C2 radical hysterectomy is a skill that is progressively acquired, preferably under the mentorship of a more skilled surgeon. Type D radical hysterectomy should be considered a variation of pelvic exenteration surgery. Surgical skills for management of cervical cancer are shown in Table 2.

3.1.1 | Nerve-sparing radical hysterectomy

Various authors have described nerve-sparing radical hysterectomy (NSRH). The essential component of the technique is to identify the inferior hypogastric nerves (in the mesoureter) that contain the autonomic nerves to the bladder, rectum, and vagina. The aim of NSRH is to prevent or contain the severity of bladder, bowel, and sexual dysfunction resulting from the damage to the autonomic nerve supply. NSRH has been criticized for a lack of standardized surgical description. A recent systematic review of available evidence and meta-analysis of data from selected high-quality studies suggested that the procedure...
is safe with oncologic outcomes comparable to conventional radical hysterectomy.\textsuperscript{10} Time to micturition, as a surrogate marker of bladder function, was significantly shorter in the NSRH group.\textsuperscript{10} The review identified significant heterogeneity in the studies included, and a significant proportion of the women in either group received adjuvant radiation therapy—an independent factor impacting on quality of life indices.

### 3.2 Radical trachelectomy and fertility-sparing surgery for cervical cancer

Cervical cancer, with its bimodal peak in incidence, is often diagnosed in women of reproductive age. With increasing age of attempted child bearing, especially in high-resource countries, fertility-preserving surgery for gynecologic cancers is at the forefront of consideration, along with oncologic outcomes and quality of life issues. Dargent is credited with pioneering the concept of radical vaginal trachelectomy, followed by description of an abdominal approach by Smith et al.\textsuperscript{11} Radical vaginal trachelectomy (RVT) had been the preferred approach for many years, especially in Europe, and the bulk of the data on safety comes from just over 1300 cases reviewed in the literature.\textsuperscript{12} The oncologic outcomes were acceptable, with a reported recurrence rate of 4% and a 2% rate of death related to recurrent disease in women with node-negative disease.\textsuperscript{12} Abdominal radical trachelectomy (ART) has gained popularity over the past decade owing to familiarity with the abdominal approach and its less resource-intensive nature for equipment and training. Data on oncologic safety are more heterogeneous for ART as the procedure has been attempted and results reported for tumors larger than those in VRT series. A recurrence rate of 4% has been reported from pooled data amounting to around 350 procedures.\textsuperscript{13}

Either VRT or ART is acceptable for carefully selected patients who are committed to fertility preservation, and who are diagnosed with squamous cell cancers, adenocarcinoma, or adenosquamous carcinomas less than 2 cm in size. Careful patient selection will minimize the rates of failed or abandoned procedures, with the exception of 10%–12% of patients who will still require adjuvant treatment following trachelectomy.\textsuperscript{13}

### 3.3 Pelvic lymph node dissection for cervical and endometrial cancers

Cervical cancer staging does not take into account pelvic nodal status. However, nodal status has a significant impact on postsurgical treatment planning and prognostication in cervical cancer.

Nodal status is an essential part of the surgicopathologic staging for endometrial cancer. The pelvic component of the nodal dissection is essentially the same for the two pathologies.

The boundaries of pelvic nodal dissection are defined as follows: medial extent limited by the internal iliac artery and its continuation as the obliterated umbilical/hypogastric artery; lateral boundary of the genitofemoral nerve overlying the psoas muscle; distal limit defined by the circumflex iliac vein crossing the external iliac artery; deep

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**TABLE 1** Modified Querleu–Morrow classification of radical hysterectomy.

| Type of radical hysterectomy | Anatomic descriptor |
|------------------------------|---------------------|
| Type A                       | Extrafascial hysterectomy, ureteric dissection, and parametrial resection not required or described |
| Type B (modified radical hysterectomy) | Resection of most medial parts (1–2 cm) of the parametrial tissues that requires deroofing the ureter and its lateral displacement. Inferior hypogastric nerves do not need to be dissected |
| Type C1                      | Equivalent of nerve-sparing radical hysterectomy. Involves more extensive resection of the lateral and dorsal parametria (uterosacral ligaments) but allows for dissection and preservation of the inferior hypogastric nerves in the mesoureter. The ureter is still attached to the ventral parametria anteriorly. Uterine artery forms the inferior boundary of resection |
| Type C2                      | Involves removal of the parametrial tissues up to the vascular bundle on the pelvic side wall. Internal iliac vessels form the lateral boundary, sacrum the posterior boundary, and ureter is completely separated from the ventral parametrium that is resected at the edge of the bladder. Inferior hypogastric nerves are sacrificed |
| Type D                       | Sacrifices the internal iliac vessels and their branches/tributaries and requires its removal. The resection extends to the obturator internus muscle laterally |

**TABLE 2** Surgical skills for management of cervical cancer.

| Mandatory                                                                 | Desirable                                                                 | Optional                                                           |
|--------------------------------------------------------------------------|--------------------------------------------------------------------------|--------------------------------------------------------------------|
| Conization                                                               | Type C2 and D                                                             | Urinary diversion procedures [pouches, conduits]                    |
| Loop electrosurgical excision procedure (LEEP)                          | Laparoscopic approach                                                     | Robotic radical hysterectomy                                        |
| Type B and C1 radical abdominal hysterectomy                             | Nerve-sparing radical hysterectomy (NSRH)                                 | Pelvic sentinel lymph node detection                               |
| Pelvic lymph node dissection                                             | Radical trachelectomy                                                     |                                                                    |
| Para-aortic lymph node dissection                                        | Pelvic exenteration                                                       |                                                                    |
| Ovarian transposition                                                    |                                                                         |                                                                    |

Abbreviation: LEEP.
dissection is usually limited to the obturator nerve and the proximal limit at the common iliac artery. The proximal limit has been variably described between the bifurcation of the common iliac to its origin at the bifurcation of the aorta.

3.4. | Minimally invasive surgery

Laparoscopic surgery has irreversibly shifted the paradigm of training in gynecological surgery. With the introduction of the levonorgestrel intrauterine system for the treatment of abnormal benign uterine bleeding, the incidence of hysterectomy has dropped sharply. This, coupled with a longer learning curve for laparoscopic surgery, has had an impact on the available opportunities for both learning and training in laparoscopic surgery for gynecologists and gynecologic oncologists. A survey of European trainees revealed dissatisfaction with the exposure to and experience in laparoscopic surgery during the course of structured gynecologic oncology training.14 Just under half of the gynecologic oncology training centers surveyed offered training in advanced laparoscopic surgery, and the numbers for robotic surgery were even lower. Over half of the trainees expressed an intention to seek additional training in advanced laparoscopic surgery outside of their home institute.

The longer learning curve for laparoscopic hysterectomy translates into longer operating time and longer theatre time for teaching cases where the trainee is the principal surgeon.15 While this should be a given in any teaching hospital, the pressures of service provision and constraints of theatre time can often hinder training opportunities.

The longer operating times for laparoscopic hysterectomy are shortened with experience and are comparable with open surgery with experience. Length of hospital stay tends to be significantly shorter for laparoscopic hysterectomy compared with open surgery for comparable indication.16,17 Laparoscopic hysterectomy is resource intensive owing to the capital outlay for equipment costs and longer theatre times, but these costs are offset by a lower incidence of postoperative complications and shorter hospital stay.18

3.4.1 | Laparoscopic hysterectomy for endometrial cancer

Endometrial cancer is the most common gynecologic cancer in high-income countries. It is certainly the most common gynecologic malignancy in the USA, Australia, and Europe—regions where the rates of obesity are high and from where the bulk of published literature on the safety and successful introduction of laparoscopic approach has been reported.19 Given that the oncologic outcomes and survival compare favorably to open surgery, as evident from prospective randomized controlled trials, laparoscopic surgery for early stage endometrial cancer should be considered as the standard management.20 The incidence of intraoperative complications is similar with laparoscopic surgery and open surgery for endometrial cancer. Laparoscopy compared favorably with open surgery, with a significantly lower incidence of major surgical adverse events postoperatively, including a lower mean drop in postoperative hemoglobin and a shorter length of hospital stay.17 More importantly, women undergoing laparoscopic hysterectomy for endometrial cancer experience a significantly better quality of life in the immediate postoperative period and up to 6 weeks after surgery compared with women undergoing abdominal hysterectomy, with significantly lower analgesic requirements, better pain scores, body image, and earlier resumption of daily activities.19,20

The difference in quality of life between the two groups levels off at 6 months after surgery. Surgical skills for management of endometrial cancer are shown in Table 3.

The success of laparoscopic surgery can be limited by both patient and surgeon limitations, as highlighted by the Gynecology Oncology Group (GOG) Lap 2 study.21 While operative difficulty due to high BMI was cited as the leading reason for conversion to laparotomy, the authors do allude to level of surgeon experience as a possible factor in the relatively higher conversion rate, compared with the LACE Trial.17,22 It should be noted that over 90% of patients underwent pelvic and para-aortic nodal staging in the Lap 2 study.21

3.4.2 | Laparoscopic radical hysterectomy for cervical cancer

There is no definitive conclusion on the role of minimally invasive surgery for surgical management of cervical cancer. While laparoscopic/robotic surgery brings with it the advantages of minimally invasive procedures to women needing to undergo radical hysterectomy and nodal dissection, the only data in the literature are from single institution or single surgeon series. Data from retrospective and single institution series suggest that laparoscopic and robotic radical hysterectomy are probably associated with acceptable oncologic outcomes, but the data are limited and long-term follow-up information is lacking.23 We require data from adequately designed, randomized controlled trials to categorically state that a minimally invasive approach

| Mandatory | Desirable | Optional |
|-----------|-----------|----------|
| Total abdominal hysterectomy and bilateral salpingo-oophorectomy | Laparoscopic approach for skills mentioned in mandatory procedures | Robotic surgery skills |
| Pelvic lymph node dissection | | Pelvic sentinel lymph node detection |
| Para-aortic lymph node dissection up to renal veins | | |
| Other standard staging procedures such as peritoneal biopsy, infracolic omentectomy, peritoneal cytology collection | | |

TABLE 3 Surgical skills for management of endometrial cancer.
does not compromise oncologic outcomes. One such trial, the Laparoscopic Approach to Cervical Cancer (LACC trial), is currently underway and the mature data will not be available until 2022. The aim is to compare the disease-related outcomes as well as quality of life indices between abdominal radical hysterectomy and laparoscopic or robotic radical hysterectomy.

The data from a single institution study, where all surgeries were performed by a single surgeon, suggest that the learning curve for laparoscopic radical hysterectomy with pelvic and/or para-aortic lymph node dissection can be as high as the first 50 cases before there was a significant improvement in surgical outcomes and reduction in complication rates.

### 3.4.3 | Laparoscopic pelvic lymph node dissection

The ability to carry out pelvic lymph node dissection laparoscopically should be an essential skill, together with laparoscopic hysterectomy, given that a significant proportion of these patients would require comprehensive staging surgery to include pelvic with or without para-aortic lymph node assessment (Fig. 2). This further adds to the learning curve with increased surgical risks of injury to the ureter, pelvic vessels, and nerves. Teaching advanced laparoscopic procedures for pelvic malignancies adds to the complications resulting from the procedure. When compared with open surgery, minimally invasive surgery did not compromise on nodal count or detection of nodal metastatic disease, but was associated with significantly lower blood loss and hospital stay.

A lack of training in laparoscopic pelvic lymph node dissection is likely to negate the benefits of training in laparoscopic hysterectomy in two ways: either the operating team is likely to convert the surgery from laparoscopic to open to complete the procedure, or there may be a temptation to omit lymph node dissection in cases where it would have been reasonably indicated. Either scenario has the potential to compromise patient outcomes. Hence, any training program with emphasis on minimally invasive procedures should include laparoscopic pelvic lymph node dissection along with hysterectomy in the curriculum.

### 3.5 | Para-aortic lymph node dissection

Lymphatic drainage of the ovaries and uterine body along the ovarian lymphatics follows their embryonic origin and blood supply from the para-aortic region. Para-aortic lymph node dissection is an essential part of staging for apparent early stage ovarian cancer and for high-risk endometrial cancer. Para-aortic lymph nodes may be microscopically involved in 18%-24% of cases of apparent Stage I and II ovarian cancer. Additionally, debulking of para-aortic nodal disease in a subset of advanced ovarian cancer with predominantly nodal spread, and in some cases of endometrial cancer, presents unique anatomic challenges owing to the proximity of the nodal disease to important vessels—namely the inferior mesenteric artery, renal vessels, and proximal ovarian vessels; and vital structures such as the ureters and duodenum. Debulking of para-aortic nodal disease requires dexterity and an intimate knowledge of the anatomy of the region (Figs 3a and 3b).
The first learning step in performing complex para-aortic nodal debulking is to learn para-aortic lymph node dissection as part of the aforementioned staging procedures with relatively normal anatomy. Traditionally, this procedure has been performed as open surgery and most of the skillset is still limited to the open approach in the vast majority of the centers. Performing para-aortic lymph node dissection laparoscopically is an additional challenge, with yet another steep learning curve. Querleu et al. had the foresight to study the learning curve for laparoscopic para-aortic lymph node dissection in a porcine model in the initial days of laparoscopy. They noted a learning curve of 14 cases to achieve adequate lymph node retrieval and the ability to complete the procedure laparoscopically without need for conversion to laparotomy for complications.

Currently there is no evidence on the clinical superiority of the robotic-assisted approach compared with traditional laparoscopic surgery in the management of endometrial cancer.

### 3.6 | Sentinel lymph node detection for pelvic cancers

Evidence for sentinel lymph node (SLN) detection for endometrial and cervical cancers has largely been described in the context of laparoscopic surgery, although early researchers did attempt to describe the concept at open surgery. Laparoscopy has the advantage of excellent vision, and newer imaging technologies have helped further the concept of SLN detection for pelvic cancers (Fig. 4). While the optimal site of injection of the tracer dye still remains largely unanswered, cervical injections seem to have been largely accepted as the preferred site for detection of pelvic SLN. Single institution prospective data and multicenter retrospective data have indicated the feasibility of robotic-assisted para-aortic lymph node dissection, with low conversion rates and acceptable morbidity.

Currently there is no evidence on the clinical superiority of the robotic-assisted approach compared with traditional laparoscopic surgery in the management of endometrial cancer.

### 3.7 | Surgery for vulvar cancer

Vulvar cancer is a rare condition, accounting for approximately 5% of all gynecologic cancers and less than 1% of all cancers diagnosed in women. Typically, vulvar cancer has been considered a disease of old age, but is increasingly being diagnosed in younger women. Until the pioneering work of Taussig and Way in the middle of 20th century, the outcome for women diagnosed with vulvar cancer was uniformly poor. Their radical surgery procedure involved en-bloc removal of the vulvar tumor, along with the inguinal and femoral nodes and overlying skin. The morbidity from this procedure was significant, often resulting in prolonged hospitalization for significant complications.

Radical local excision, as opposed to radical vulvectomy, for smaller tumors with at least 1 cm macroscopic margin or 8 mm of pathologic margin has further reduced the morbidity associated with vulvar cancer surgery. Radical vulvectomy is still recommended for larger tumors, multifocal disease, or associated field change with extensive pathologically.
premalignant disease. The procedure involves removal of all vulvar tissues with dissection carried deep to the pubic bone anteriorly and inferior urogenital diaphragm posterolaterally. Surgical skills for management of vulvar cancer are shown in Table 4.

The technique for inguinofermal lymph node dissection has also undergone a major shift, from the days when removal of skin overlying the femoral triangle and the skin bridge between the vulva and the groin was advocated, to an increasingly conservative surgical approach that can be carried out through much smaller incisions. The dissection should aim to remove all lymph nodes medial to the femoral artery, both superficial and deep to the cribriform fascia.35

3.7.1 | Groin sentinel lymph node detection

Detection of SNL in the groin or inguinofermal group of lymph nodes has been around for several years. Although there are no randomized controlled trials on its efficacy and safety, data are available from two multicenter prospective observational studies on its feasibility and safety in unifocal vulvar cancers under 4 cm in maximal dimension. Concerns related to false-negative rates persist, but the procedure is an option available to women who cannot [owing to medical issues] or would not undergo full lymph node dissection (Fig. 5). Full lymph node dissection should still be considered as the gold standard of care in women presenting with vulvar cancer.

Long-term, disease-specific, and survival data following performance of the sentinel node procedure from the Groningen International Study on Sentinel Nodes in Vulvar cancer (GROINSS-V) I was recently published.36 This is one of the two largest prospective observational studies on the role of sentinel nodes in vulvar cancer. The long-term data suggest an isolated groin recurrence rate of 2.5% for SNL-negative patients with vulvar tumors less than 4 cm who only underwent SNL detection without inguinofermal lymph node dissection. All recurrences were diagnosed within 16 months of first surgery. All patients diagnosed with isolated groin recurrences succumbed to the disease.

The main reason for selecting the SNL procedure over complete inguinofermal lymph node dissection is to avoid a 50%–70% risk of lower limb lymphedema following the removal of all groin lymph nodes.37 The risk rises to almost 100% if surgery is followed by adjuvant radiotherapy. On the other hand, groin recurrences are usually fatal, as reported in several series. The inclination to prevent lower limb lymphedema should be balanced against patient perceptions of risks of the procedure. In an Australian study, 80% of women who had previously been treated for vulvar cancer stated that they would choose complete lymph node dissection over the SNL procedure if the quoted false-negative rate for SNL was 5%.37

Most reliable data on the learning curve for adequate performance of the SNL procedure come from studies on breast cancer. It was noted that a surgeon needed to perform at least 23 procedures to achieve over a 90% detection rate, with incremental gains in the success of SNL detection to 95% with over 30 procedures. Authors of the GOG 173 study have alluded to lack of surgeon experience and low volume of cases per surgeon as factors contributing to the false-negative rate. They emphasized institutional and individual surgeon competence, as well as the ability of the institution to provide ultrastaging of the SNL to detect low-volume metastatic disease for the SNL procedure to be safe and acceptable as a surgical option.38

Levenback et al.39 recommend that the groin SNL procedure for management of vulvar cancer be offered only after careful discussion with the patient and offering full lymph node dissection as the standard of care. Additionally, the ideal candidates for groin SNL detection are women with unifocal tumors less than 4 cm in maximal dimension.38 A full inguinofermal lymph node dissection should be carried out in the event of failure to identify the SNL in the groin. The authors of the GROINSS-V study suggest that the learning curve of 10 patients, comprising of surgery on 15–20 groins, for SNL detection in vulvar cancers should be adequate.39 Although arbitrary, the figure is close enough to the numbers noted in breast cancer SNL studies. These procedures should be performed under the mentorship of a skilled operator with a low threshold for proceeding with full lymph node dissection if sentinel nodes are not identified. The gynecologic oncologist should maintain a personal log of cases and audit the same regularly to ensure patient safety.

TABLE 4  Surgical skills for management of vulvar cancer.

| Mandatory                          | Desirable                          | Optional                      |
|------------------------------------|------------------------------------|-------------------------------|
| Radical vulvectomy (triple incision) | Sentinel lymph node biopsy         | Graciloplasty                 |
| Radical wide local excision         | Distal urethral and vaginal resection | Island flaps                  |
| Modified radical vulvectomy         | Rotational flap reconstruction      | Video endoscopic assisted groin dissection |
3.7.2 | Plastic surgery for vulvar cancer

Long-term data from the GROINSS-V study would suggest that 40% of women experience a recurrence of vulvar cancer over a 10-year follow-up. This means that nearly one in two women would require repeat surgery for vulvar cancer. A significant proportion of women present with a large-volume primary tumor that may require plastic reconstructive procedures to close the defect with good blood supply and avoid undue tension on the wound. Re-excision for recurrent vulvar cancer after previous radiotherapy is associated with a high risk of wound complications, and plastic repair with nonirradiated musculocutaneous grafts offers the best chance to close the defect and promote healing as they bring fresh blood supply to the affected area.

Plastic surgical procedures can offer some semblance of normal appearance after a surgical procedure that may leave a patient with significant disfigurement of the vulvar region.

Plastic surgical procedures may range from simple advancement flaps or V-Y plasty to allow the closure of the defect, to more complex plastic procedures such as lotus flaps or Singapore flap reconstructions. Gynecologic oncologists should be able to perform simple advancement flaps to allow adequate wound closure without tension, but may require the assistance of plastic surgeons for more complex vascular pedicle or musculocutaneous flap repairs.

3.8 | Surgery for advanced stage ovarian cancer

Ovarian cancer presents with peritoneal and/or nodal metastatic disease in 75% of women at diagnosis. Gynecologic oncology has witnessed an increasingly aggressive approach to cytoreductive surgery for ovarian cancer since the time Meigs described the benefit of reduction in tumor volume, to Griffiths’ landmark paper that provided the first scientific evidence of an inverse relationship between tumor volume and patient survival. The definition of “optimal cytoreduction” has changed over the years to less than 2 cm maximal residual disease to the current definition of less than 1 cm residual disease as defined by the GOG.

The consensus from the Gynecological Cancer InterGroup (GCIG) Fourth Ovarian Cancer Consensus Conference in 2010 was to define “optimal debulking” as the absence of any residual disease or no gross residual disease.

The scope of surgical resections undertaken by a gynecologic oncologist has progressively expanded to include small and large bowel resections, diaphragmatic surgery (Figs 6a and 6b), splenectomy, distal pancreatectomy, subsegmental liver resection, and mesenteric peritoneal resection. In some regions the scope has gone even further to include partial/sleeve gastrectomy, cholecystectomy, and resection of disease from the porta hepatitis. Surgical skills for management of ovarian cancer are shown in Table 5.

The risks of complications and adverse impact on quality of life increase surgical procedures become more complex. The decision to perform additional surgical procedures should be based on presentation, performance status, impact on symptomatology, and ability to achieve no gross residual disease. In a retrospective review of 2655 women who participated in the GOG 182 study, performance of upper abdominal surgical procedures that largely included diaphragmatic surgery had an equivocal impact on progression-free survival and overall survival. The positive impact of these procedures was noted as a function of the proportion of women achieving no gross residual disease (i.e. women who had no gross residual disease had a significantly superior progression-free survival and overall survival compared with those who did not achieve no gross residual disease). The impact of upper abdominal procedures on progression-free survival or overall survival was not statistically significant, leading the authors to conclude that these procedures should only be performed if no gross residual disease is achievable. This is probably the most important message from the available literature on extended cytoreductive procedures either alone in combination. The complexity and extent of the procedure should be weighed against the likely morbidity, preoperative status of the patient, their wishes, and ability to achieve no gross residual disease.

The other issue that arises from the retrospective review of surgical outcomes from the GOG 182 and SCOTROC-1 trials is whether ability to achieve no gross residual disease is a function of better disease biology rather than maximal surgical effort. The authors argue that maximal surgical effort to include increasingly complex procedures cannot overcome aggressive disease biology.

Extended cytoreductive procedures, especially a combination of complex surgical procedures in addition to standard pelvic surgery and omentectomy, increase the risk of 30-day major morbidity as well risk.

FIGURE 6  (A) Diaphragmatic stripping/resection and Glisson capsulectomy; (B) Post diaphragmatic surgery and Glisson capsulectomy.
of 30-day mortality. Complex surgery was an independent risk factor associated with short-term major adverse events in both univariate and multivariate analysis. These adverse events were noted in nearly one in five patients undergoing extended cytoreduction.\textsuperscript{45} A meta-analysis of treatment outcomes involving over 2000 patients revealed a survival benefit of 3 months for each 10% increase in the proportion of women who underwent complete debulking surgery for advanced ovarian cancer.\textsuperscript{46} The data were derived from 40 cohorts of retrospective, prospective nonrandomized, retrospective case-controlled studies, and personal communications. A further meta-analysis of treatment outcomes for over 13,000 patients in the era of changing treatment paradigms showed a 2.3 month survival advantage for each 10% increase in the proportion of women undergoing complete debulking.\textsuperscript{47} It is important to note that while this information has influenced our practice, this is post hoc analysis of data that was not originally powered or intended to answer the question of impact of surgical debulking on survival outcomes. In the absence of any relevant data from well-designed randomized controlled trials, this is the best information currently available to be able to counsel women on the benefits of extended cytoreduction for ovarian cancer.

Despite the information from these studies with a large volume of patient data, a Cochrane review on the role of extended cytoreductive surgery or “ultra-radical surgery” involving complex upper abdominal procedures failed to reveal good quality evidence in favor of these procedures when evaluated against survival as the outcome measure.\textsuperscript{48} There was also a lack of data on the impact of these procedures on quality of life. This is a reflection of lack of prospective evidence from well-designed randomized trials and a difficulty in standardizing the most important factors impacting on outcome, i.e., disease burden, surgical effort, and surgeon performance.

### 3.8.1 | Extended cytoreductive procedures for management of advanced stage ovarian cancer

Ovarian cancer is a locoregional disease with locoregional effects leading to symptoms and presentation typical of advanced ovarian cancer. Typically, the symptoms are related to the mass effect of the tumor involving the omentum, or the mass effect of pelvic disease involving the pelvic colon. Omental disease can cause symptoms related to the upper gastrointestinal tract, or uncommonly, involvement of the transverse colon. Total omentectomy to remove the supracolic omentum is often necessary to achieve relief of symptoms and for cytoreduction. Identification of the lesser sac allows a thorough inspection of the peritoneal cavity to identify anatomic relationships. Splenectomy may be required if the disease extends to the splenic pole or hilum along the omentum; rarely it is required to manage splenic injury at the time of omentectomy. The pancreatic tail is at risk during this procedure. If involved with the disease process, some surgeons may elect to carry out a distal pancreatectomy at the same time. The need to perform a splenectomy usually reflects the advanced stage of disease at the time of cytoreduction.\textsuperscript{49} Transverse colectomy is an infrequently performed operation as it is almost always possible to dissect the omental mass off the transverse colon. In their review of cases and description of operative technique, Bristow et al.\textsuperscript{50} noted that over half of the patients had an additional colonic resection of a noncontiguous segment, mostly rectosigmoid colon, along with transverse colectomy, and one in two had two colonic reanastomosis. In this series, one-quarter of patients experienced postoperative morbidity and 5% of cases were complicated by postoperative fistula.

Resection of pelvic disease is often complicated by involvement of the pelvic peritoneum in the pouch of Douglas. Radical excision of pelvic peritoneum requires complete ureterolysis to allow en-bloc resection of the posterior pelvic peritoneum and often a retrograde hysterectomy to facilitate dissection off the rectum (Fig. 7).

The pelvic disease process may invade into the pelvic colon or its mesentery or present with impending obstruction. Surgery may require primary en-bloc resection of the rectosigmoid colon with low or ultra-low anastomosis to relieve the obstruction or to achieve optimal debulking (Fig. 8). The technique and results of en-bloc rectosigmoid resection have been well detailed in the literature and the procedure is not without its risks.\textsuperscript{51,52} A gynecologic oncologist should be able to dissect the pararectal and presacral planes to identify the pelvic structures and isolate the disease process.

The ability to perform bowel resection and anastomosis will depend on the training and institutional support. In the event of inability to relieve impending or established bowel obstruction, a gynecologic oncologist should be able to perform a Hartmann procedure and end colostomy, a loop colostomy, and a loop ileostomy.

Diaphragmatic surgery forms part of the extended cytoreductive surgical techniques, which require mobilization of the liver and its attendant risk of injury to the liver, hepatic veins, inferior vena cava and the risks related to the diaphragmatic surgery itself; most

| Table 5 | Surgical skills for management of ovarian cancer. |
|---------|--------------------------------------------------|
| **Mandatory** | **Desirable** | **Optional** |
| • Total abdominal hysterectomy and bilateral salpingo-oophorectomy | • Rectosigmoid resection and anastomosis | • Hyperthermic intraperitoneal chemotherapy (HIPEC) |
| • Pelvic lymph node dissection | • Small and large bowel resection and anastomosis | • Liver metastasectomy |
| • Para-aortic lymph node dissection up to renal veins | • Appendectomy | • Gastric sleeve resection |
| • Pelvic peritoneectomy including vesical and pouch of Douglas | • Splenectomy | • Cholecystectomy |
| • Total/supracolic omentectomy | • Diaphragmatic peritoneal stripping | • Lesser omentectomy |
| • Peritoneectomy | • Diaphragmatic resection | • Ollson capsulectomy |
| • Stomas (ileostomy/colostomy) | • Intraperitoneal port insertion | • Mesenteric peritoneal stripping |
commonly pleural effusions, hemothorax, pneumothorax, and respiratory compromise.

3.8.2 | Hyperthermic intraperitoneal chemotherapy in ovarian cancer

In 2018, van Driel et al.\textsuperscript{53} published a multicenter, open-label, Phase 3 trial, randomized controlled trial where 245 patients who had at least stable disease after three cycles of carboplatin and paclitaxel underwent interval cytoreductive surgery either with or without administration of HIPEC with cisplatin. The results indicated that disease recurrence or death occurred in 110 of the 123 patients (89%) who underwent cytoreductive surgery without HIPEC (surgery group) and in 99 of the 122 patients (81%) who underwent cytoreductive surgery with HIPEC (surgery-plus-HIPEC group). The median recurrence-free survival was 10.7 months in the surgery group and 14.2 months in the surgery-plus-HIPEC group. The median overall survival was 33.9 months in the surgery group and 45.7 months in the surgery-plus-HIPEC group. The authors concluded that among patients with Stage III epithelial ovarian cancer, the addition of HIPEC to interval cytoreductive surgery resulted in longer recurrence-free survival and overall survival than surgery alone and did not result in higher rates of adverse effects.\textsuperscript{53}

3.8.3 | Issues related to training in advanced surgical procedures

The ability to incorporate training of advanced surgical procedures that have traditionally been outside the domain of gynecologic oncologists (such as colorectal and urologic procedures) can be dependent on work culture factors such as institutional and specialty support, and case load of the department. Gynecologic oncology units with an appropriate case load may be able to provide adequate training in gastrointestinal procedures within the realm of the training program.\textsuperscript{54} However, a process of cross-specialty rotations to gain additional experience in surgery and postsurgical management is one of the strategies to enhance surgical skills in this community. Additionally, surgical training in well-designed animal labs and surgical training courses are valuable in teaching the principles of extended surgical procedures.\textsuperscript{55}

Surgical skills for colorectal and urologic procedures are shown in Table 6.

4 | FACTORS ASSOCIATED WITH SURGICAL OUTCOMES

It is a well-established fact that surgical, especially oncologic, outcomes vary between surgeons and institutions.\textsuperscript{56} This is true for most surgical oncology specialties. Ovarian cancer is one of the conditions for which the impact of surgeon specialty and place of surgery has been addressed extensively in the literature from different parts of the world. In a retrospective review of cases, gynecologic oncologists were more likely to achieve complete or optimal debulking for ovarian cancer and were more likely to adhere to the guidelines for postoperative treatment with platinum-based chemotherapy.\textsuperscript{1,2} The overall survival was significantly better for the cohort of women treated by a gynecologic oncologist. A systematic review of impact of surgeon specialty and institutional specialty on survival following ovarian cancer treatment found a similar trend. The survival was better when a gynecologic oncologist treated women diagnosed with ovarian cancer; this difference was more profound for advanced stage disease. The impact of the institutional specialty showed a similar trend although did not reach statistical significance.\textsuperscript{1}

Another review into the impact of hospital and physician volume of work on the outcome of women diagnosed with advanced stage ovarian cancer found that women treated by high-volume physicians (those with a case load of more than 10 cases per year of advanced
ovarian cancer) in high-volume hospitals (those with a case load of more than 20 cases per year) had a much better outcome than any other combination of physician and hospital case load.²

5 | INSTITUTIONAL AND SELF-GOVERNANCE

Assessment and documentation of surgical competence is a complex matter, and largely outside the scope of this paper. The authors do feel a sense of responsibility to allude to the issue of surgical competence given the ever-extending scope of practice in gynecologic oncology, with an increasing array of colorectal, urologic, and upper abdominal procedures being performed by gynecologic oncologists. A log of all surgical procedures performed is essential for documentation and aids certification assessment. However, a surgical log should not be surrogated for surgical competence. Surgical competence and skill do not correlate well with the number of cases performed.⁵⁷ Mentorship, objectivity in assessment, trainee/trainer feedback opportunities, and peer review of practice should be the cornerstones of any good surgical training program. Ongoing self-evaluation, with or without peer review, is an essential component of any surgical practice.

In addition to the surgical skills acquired during training and fellowship, surgical practice should be dictated by the skills retained in a surgeon’s role as a specialist. Individual insight into their capabilities is the key to safe surgical practice. Surgeons should only perform procedures that are commensurate with their skill level. Audit of self-practice and ongoing log of complications are the key to self-governance. In addition to this, the hospitals and medical institutions should have clinical governance to assess the scope of practice of individual surgeons and collectively at the service provided by the departments. The individual’s scope of practice should be based on demonstrated training in the procedures they have claimed to receive training in and achieved proficiency. This should be supplemented with an ongoing process of peer review and review of the scope at regular intervals. Institutional governance should also include the ability of the facility to provide level of perioperative care commensurate with the extent and complexity of the surgery. The hospital or facility should also be agreeable to support the surgical team in terms of the expected length of stay and increased morbidity that come with performing extended surgical procedures.⁵⁸

6 | CONCLUSION

We have alluded to ongoing training and mentorship in this article. As surgical techniques evolve and newer technologies are introduced, gynecologic oncologists will need to seek additional training from their peers as ongoing process in not only the immediate post-fellowship phase of a young consultant, but as an ongoing process that addresses not only their surgical skills but also the decision making associated with complex presentations and myriad management options. There is a lesson to be learnt in ongoing learning from the mentorship program introduced at the MD Anderson Cancer Centre.⁵⁷ The program highlights the need to support a young gynecologic oncologist even after a grueling 3–4-year fellowship program.

The key message from this article is that surgical skill is a continuous spectrum and achieving expertise in complex pelvic surgery is a continuous process that develops over several years. It requires ongoing mentorship, self-reflection, and seeking training opportunities with peers even when the surgical role has transitioned from a trainee to a trainer.

AUTHOR CONTRIBUTIONS

VA and SSP contributed equally to the literature search, concept and design, and writing of the paper.

ACKNOWLEDGMENTS

The clinical photographs presented are from the authors’ personal library and were taken with the consent of the patients.

CONFLICTS OF INTEREST

The authors have no conflicts of interest to declare.

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