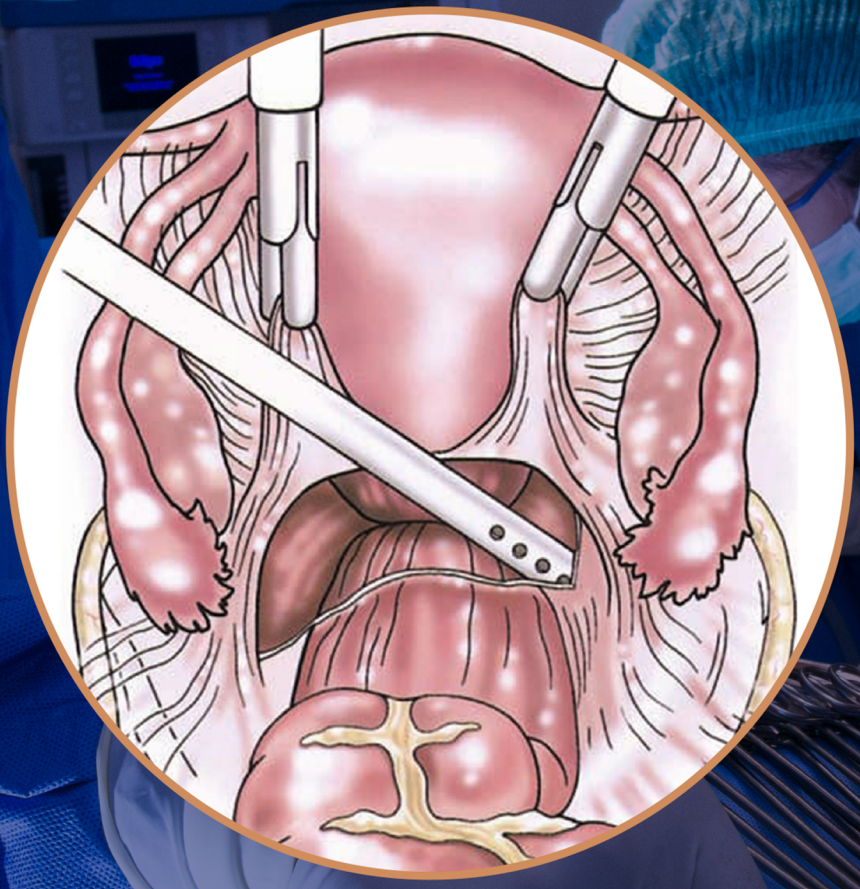
FOURTH EDITION

AN ATLAS OF GYNECOLOGIC ONCOLOGY

Investigation and Surgery



Edited by

J. RICHARD SMITH • GIUSEPPE DEL PRIORE

ROBERT L. COLEMAN • JOHN M. MONAGHAN

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FOURTH EDITION

AN ATLAS OF GYNECOLOGIC ONCOLOGY

To my four children, Cameron, Victoria, Madeleine and Lara, thank you for being there for Dad.

JRS

To my family—from the smallest latest joyous addition, to the oldest and wisest, some departed, and in the center of them all, my wife, Men-Jean Lee.

GDP

To my extraordinary wife, Fay, for her unwavering support and understanding, mentorship, love and friendship and to our six blessing children, of whom I could not be prouder. And, to my Parents, who through their years of sacrifice and guidance enabled me to pursue my dreams.

RLC

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AN ATLAS OF GYNECOLOGIC ONCOLOGY

Investigation and Surgery

Edited by

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Preface

Welcome to the fourth edition of this Atlas. When we looked back to the first edition, instituted 20 years ago now, that text was approximately half the size of this current volume. Much of what is now included would have appeared to be science fiction 20 years ago, but it has become reality. Inevitably, the book gets larger with each expanding edition as the gynecologic oncologist's repertoire of operations gets progressively larger. There are virtually no operations which fail to remain in the skill set, only ever more to know about and ever more equipment and energy sources available. A number of the procedures described are nowadays often performed as laparoscopic or robotically assisted procedures; however, we are also aware that not all surgeons have access to the same equipment, and this is an international book designed for an international audience.

The "cookbook" formula of the previous editions remains; nobody is advising which operation to do, but you do get a "road map" to whichever operation you have decided upon. Many years ago, before satellite navigation systems in cars, if you were going on a long drive you would consult your road atlas the previous night; this book, it is hoped, fulfils a similar role, as well as opening our minds to new things, some of which we may develop, others not.

New chapters have been added and all the text updated by a combination of the chapter authors and the editors. As in previous editions, innovative surgeons have been keen to contribute. The wonderfully clear artwork of Dee McLean and Joanna Cameron continues to enhance this book, allowing easy step-by-step breakdowns of procedures.

Once again it has been a great pleasure and privilege to be the editors and to read so many clear expositions written by experts for experts. We hope you enjoy reading this book as much as we have enjoyed editing it.

J. Richard Smith
Giuseppe Del Priore
Robert L. Coleman
John M. Monaghan

Acknowledgments

J. Richard Smith would like to thank Miss Rodena Kelman and Miss Alison Irvine Smith for their secretarial support and Dr. Charles Lockwood and Professor Philip J. Steer for the academic environment which encouraged the editors in the early days. He would also like to express his gratitude to his research fellow, Mr. Benjamin Jones, for editorial assistance and also to Dr. David Keefe, of NYU Medical Center, for his ongoing support and collaboration. In addition, he thanks all his colleagues at the West London Gynaecological Cancer Centre, particularly Mr. Alan Farthing, Ms. Sadaf Ghaem-Maghami, Ms. Christina Fotopoulou, Ms. Maria Kyrgiou, Mr. Joseph Yazbek, and Professor Hani Gabra, for the supportive environment they engender for this project and many others.

Giuseppe Del Priore wishes to thank his family for indulging his trainees for constant inspiration to learn and teach more. He thanks his colleagues for their continued guidance and constructive feedback.

Robert L. Coleman would like to thank his wife, Fay, and his expanding family for their inspiration, sacrifice, and support to make this all possible; his colleagues and trainees who confidently and consistently ask "why?" and "what if?" as they care for our patients; his trusted friends and brilliant collaborators, Professors Anil Sood, Tom Herzog, and Bradley Monk, who continually challenge him to think bigger and reach deeper; and Ms. Kathleen Collins, Ms. Elizabeth DelBosque, Ms. Ljiljana Milojevic, Ms. Marlana Klinger, and the dedicated team of research nurses, data coordinators, and regulatory staff, whom he's been privileged to work alongside, for their tireless attention to their research program, which strives to better understand the disease process and move the needle on treatment efficacy and safety.

John M. Monaghan would like to thank his fellow editors for keeping him on side and for allowing him to use the experience of time to occasionally add a comment or two. He would particularly like to thank Maggie, his wife of over 50 years, for her continuing patience and encouragement. It has been a privilege to be involved in this book for over 20 years and to see how fully the field of gynecological oncology has progressed to be the major surgical care system for women. When the editors began, laparoscopic surgery was an occasionally used tool; it is now the major route of access for even the most massive of procedures. The resulting shortening of inpatient care and rapid discharge of patients has had many benefits but occasional problems. Careful scientific analysis of systems of care and techniques of management are now standard in gynecological oncology, yet the subject remains innovative and not confined by the stifling atmosphere of safety and nil risk. He sees a strong future of innovation and development for the subject and is happy to have contributed to this important text.

In Memoriam: Andrew D. Lawson

In 2014 Andrew Lawson, pain specialist, anesthetist, and ethicist, succumbed to a pleural mesothelioma after a 7-year battle with his disease. The editors wish to acknowledge his great contribution to the field of chronic pain management and to record his efforts for the first three editions of this book, the latter while very much under the cloud of his diagnosis. He was known personally to many involved with this book and is much missed.

1 Introduction: Preparing a patient for surgery

Srdjan Saso, Benjamin P. Jones, J. Richard Smith, and Giuseppe Del Priore

INTRODUCTION

This chapter reviews three specific areas relevant to virtually all surgical procedures and surgeons: infection prophylaxis; deep venous thrombosis (DVT) prophylaxis; and universal precautions. Universal precautions facilitate the protection of surgeons and their assistants, medical and nursing, and patients. Preoperative and postoperative checklists now form a vital part of risk reduction. James Reason, PhD, formulated the "Swiss cheese theory" of risk. This is based on a piece of Swiss cheese with holes in it. The more slices one puts in the cheese, the less likely it is that an arrow could fly through the holes, and thus the holes are less likely to tally with each other. Therefore the more layers of checking that one puts in pre- and postoperatively, the less likely it is that the antibiotic prophylaxis will be forgotten or the postoperative DVT prophylaxis will not be given. A simple checklist is shown in Figure 1.1. The purpose of any such checklist is to systematically and efficiently ensure that all operative conditions are optimal with respect to patient safety. The hope is that by completing such a checklist, the lives and well-being of surgical and thus gynecological patients will be minimized as errors in patient identity, site, and type of procedure are avoided completely.

More well known is the surgical checklist published by the World Health Organization (WHO) in 2008 in order to increase the safety of patients undergoing surgery. It is officially known as the *WHO Surgical Safety Checklist and Implementation Manual.* It is now used in general surgery, orthopedics, and obstetrics and gynecology. The operation is divided into three distinct phases by the checklist. Each phase corresponds to one of the following periods: (a) before the induction of anesthesia, (b) before the skin incision (known as "time out"), and (c) before the patient leaves the operating facility (known as "sign out"). A "checklist coordinator" must confirm that the surgical team has completed a phase before moving on to the next. Only when all three phases have been completed can the procedure commence.

Phase I: Before Induction of Anesthesia. The following must be confirmed first: patient identity, site of operation, procedure to be carried out, and consent. Type of anesthetic required, allergies (if any), and expected blood loss should be discussed. Phase I is to be completed by the anesthetist.

Phase II: Time Out. This refers to a process before the first incision where all present in the room must introduce themselves by name and role. The patient name and the planned procedure are then confirmed as well as any surgical or anesthetic critical events that may occur. The need for antibiotics, DVT prophylaxis, and imaging is highlighted. Phase II is to be completed by the surgeon and anesthetist.

Phase III: Sign Out. The final phase is performed before the patient leaves the operating room. Swabs, instruments, and needle counts are done, the equipment is checked (including disposables), and the specimens are checked as properly labeled. The postoperative recovery process is discussed. Phase III is to be completed by the surgeon or nursing staff.

Figure 1.1 shows the checklist on admission for surgery.

THROMBOEMBOLIC DISEASE

Venous thromboembolic disease (VTE) is a significant cause of morbidity and mortality in gynecologic oncology patients. If sensitive methods of detection are employed and no preventive measures are taken, at least 20% and as many as 70% of gynecologic cancer patients may have some evidence of thrombosis. In certain situations, such as with a long-term indwelling venous catheter of the upper extremity, nearly all patients will have some degree of VTE, though it may not be clinically significant. On the other hand, lower extremity VTE has a much more certain and clinically significant natural history. Venous thromboses below the knee may spread to the upper leg in approximately 10% to 30% of cases or resolve spontaneously in approximately 30%. Once the disease has reached the proximal leg, the risk of pulmonary embolism (PE) increases from less than 5% for isolated below-the-knee VTE to up to 50% for proximal VTE. The mortality rate for an undiagnosed PE is high. Up to two-thirds of patients who die from PE do so in the first 30 minutes after diagnosis.

Early recognition and effective treatment can reduce this mortality. However, postoperative VTE is still a leading cause of death in gynecologic oncology patients. In the past, it was clear that only one-third of hospitalized high-risk patients received appropriate prophylaxis; this figure has now much improved, particularly with the use of checklists. Risk factors are listed in Table 1.1 (NICE 2015).

PREVENTION AND RISK ASSESSMENT

Patients may be considered for prevention of VTE based on their clinical risk category. Laboratory tests such as euglobulin lysis time do correlate with the risk of VTE but are no more helpful than clinical risk assessment in selecting patients for prophylaxis. Low-risk patients are young (less than 40 years old), undergoing short operative procedures (less than 1 hour), and do not have coexisting morbid conditions such as malignancy or obesity that would elevate the risk of VTE. Moderate-risk patients include those undergoing longer procedures, older or obese patients, and patients having pelvic surgery. High-risk patients include otherwise moderate-risk patients who have cancer and those with a previous history of VTE. Positioning for vaginal surgery lowers the risk of VTE when compared with the abdominal approach.

All patients should be assessed for risk of bleeding before being offered pharmacological VTE prophylaxis. This should not be offered to patients with any of the risk factors for

CHECKLIST FOR SURGERY ON ADMISSION
Date:

NAME: DATE OF BIRTH:

OPERATION PLANNED:

RISKS	
Infection	
Anesthetic	
Hemorrhage	
Deep Venous Thrombosis	
Uterine Perforation	
Other Organ Damage	
Others	

PAST GYNECOLOGICAL HISTORY	
Last Menstrual Period	
Contraception	
x/y	
Pregnancy Test	

PERTINENT MEDICAL/ANESTHETIC PROBLEMS

Signed _____

POST-OPERATIVE CHECKLIST	
Low molecular weight heparin or other measures prescribed	
Antibiotics prescribed	
Photographs taken and collected	

Signed _____

1

Figure 1.1 Checklist for surgery on admission.

Table 1.1 Risk Factors for VTE (NICE 2015)

- Active cancer or cancer treatment
- Age over 60 years
- Critical care admission
- Dehydration
- Known thrombophilias
- Obesity (body mass index [BMI] over 30 kg/m^2)
- One or more significant medical comorbidities (for example, heart disease; metabolic, endocrine, or respiratory pathologies; acute infectious diseases; inflammatory conditions)
- Personal history or first-degree relative with a history of VTE
- Use of hormone replacement therapy
- Use of estrogen-containing contraceptive therapy
- Varicose veins with phlebitis

bleeding shown in Table 1.2, unless the risk of VTE outweighs the risk of bleeding. Patients should be advised to consider stopping estrogen-containing oral contraceptives or hormone replacement therapy 4 weeks before elective surgery. If stopped, advice must be provided on alternative contraceptive methods (NICE 2015). All patients should have some form of VTE prevention. This first begins with risk reduction. Patients should not become dehydrated unless clinically indicated. They must mobilize as soon as possible. Aspirin or other antiplatelet agents should not be considered as adequate prophylaxis for VTE. Finally, temporary inferior vena caval filters should be offered to patients who are at very high risk of VTE (such as patients with a previous VTE event or an active malignancy) and for whom mechanical and pharmacological VTE prophylaxis are contraindicated (NICE 2015).

VTE prophylaxis can be in the form of mechanical or pharmacological prophylaxis. The ultimate decision is based on individual patient factors including clinical condition, surgical procedure, and patient preference. Mechanical prophylaxis can be anti-embolism stockings (thigh or knee length), foot impulse devices, or intermittent pneumatic compression devices (thigh or knee length). Pharmacological prophylaxis is based on local policies and individual patient factors, including clinical condition (such as severe renal impairment or established renal failure) and patient preferences (NICE 2015).

Table 1.2 Risk of Bleeding (NICE 2015)

- Active bleeding
- Acquired bleeding disorders (such as acute liver failure)
- Concurrent use of anticoagulants known to increase the risk of bleeding (such as warfarin with international normalized ratio [INR] higher than 2)
- Lumbar puncture/epidural/spinal anesthesia expected within the next 12 hours
- Lumbar puncture/epidural/spinal anesthesia within the previous 4 hours
- Acute stroke
- Thrombocytopenia (platelets less than 75×10^9/L)
- Uncontrolled systolic hypertension (230/120 mmHg or higher)
- Untreated inherited bleeding disorders (such as hemophilia and von Willebrand disease)

Low-risk patients, with an incidence of approximately 3% for VTE, may be adequately protected with early ambulation, elevation of the foot of the bed, and graduated compression stockings. "Early ambulation" has been defined by some investigators as walking around the nursing station at least three times within the first 24 hours. Graduated compression stockings are readily available; however, ensuring their proper application and size can be difficult. Obese patients may suffer from a "tourniquet" effect if the stocking rolls off the thigh; this may actually increase the risk of VTE, not prevent it.

Moderate-risk patients include the majority of general gynecology patients and have approximately 10% to 40% chance of developing VTE. These patients should receive the same measures as low-risk patients with the addition of low-dose unfractionated low molecular weight heparin (LMWH), 5000 units subcutaneously twice a day. An alternative to the administration of heparin is the application of pneumatic compression devices to the lower extremities. High-risk category patients require even more measures owing to the estimated 40% to 70% risk of VTE.

The vast majority of gynecologic oncology cases will fall into the high-risk category. Standard unfractionated heparin (UH) is ineffective in these cases in low doses; for example, 5000 units twice daily. If given three times daily, UH is effective but no better than pneumatic calf compression. Unfortunately, more frequent dosing is associated with significantly more wound hematoma formation and blood transfusions. It also requires additional nursing and pharmacy personnel time, and is more uncomfortable for the patient. These may be some of the reasons only a minority of surgeons regularly use UH prophylaxis. Unfortunately, although compression devices are effective in gynecologic oncology patients, the devices are somewhat cumbersome, and are disliked by patients and nursing staff. In fact, improper application of the devices occurs in approximately 50% of patients on routine inpatient nursing stations. Compression devices are also contraindicated in patients with significant peripheral vascular disease.

The LMWHs have many potential advantages over the previously cited alternatives. Excellent bioavailability allows for single daily dosing, which in turn reduces nursing effort while improving patient satisfaction. This form of prophylaxis is also associated with less thrombocytopenia and postoperative bleeding. Patients with UH-associated thrombocytopenia will usually tolerate LMWH. In summary, in high-risk patients such as gynecological patients, LMWH may be more efficacious, more cost-effective, and less toxic than the alternatives.

Many other agents have been tried in an attempt to overcome the imperfections of existing options. All have limitations and are not used routinely. However, all are effective to some degree and may be appropriate in highly selected patients. Some of these agents include aspirin, warfarin, and high molecular weight dextran. The most promising are direct thrombin inhibitors and oral factor Xa inhibitors such as Rivaroxaban. In comparison with LMWH, aspirin results in more bleeding complications and is less effective than heparin in preventing VTE. Warfarin has a prophylactic effect similar to aspirin, but again is less effective than heparin and is associated with a higher risk of complications and requires more intensive monitoring. Dextrans are effective but have been associated with rare cases of allergic reactions. Other complications reported include fluid overload and nephrotoxicity. Further research to avoid some of these limitations may improve the therapeutic value of these alternatives.

PREVENTION AND TREATMENT

The duration of prophylaxis has traditionally been limited to the duration of hospital stay. In many older studies, when health care was less cost-conscious, this may have been several days to weeks. Lengths of stay are now much shorter, and as a result so is the duration of VTE-preventive measures. Even before this forced change in clinical practice, it was recognized that a significant minority of VTE either developed or was diagnosed long after discharge from the hospital. The optimal duration of prophylaxis is still not known and depends on the method used. For instance, patients should be instructed to walk every day once discharged from the hospital. Similarly, graduated compression stockings may be worn after surgery until discharge with little risk and possibly some benefit. Some authors also advocate compression stockings to be worn at home following discharge. Conversely, pharmacologic therapies have side effects, may require some training (e.g., self or nurse injections), and are associated with considerable cost. General guidance used to be to use prophylaxis until the patient is fully mobile. However, following the demonstration that administering LMWH for 4 weeks, when compared to a single-week course, reduces VTE risk by 60% in postoperative cancer patients, generally a 4-week course is now prescribed (Bergqvist et al. 2002).

The agents discussed above are all designed to prevent VTE and thereby reduce the risk of developing a clinically significant PE. When these methods are used properly, most patients will not develop VTE and therefore will be at low risk for a PE. However, it is not uncommon for a gynecologic oncology patient to present with VTE as the first manifestation of disease. For instance, it is the presenting symptom in up to 10% of ovarian cancer patients. In these patients, and in those who develop VTE despite appropriate prophylaxis, something must be done to prevent the progression to a potentially fatal PE. This becomes especially difficult if the patient requires surgical treatment for the malignancy.

One common management technique for these difficult situations is mechanical obstruction of the inferior vena cava. This can be accomplished preoperatively via peripheral venous access and interventional radiologic techniques. Care must be taken to delineate the extent of the clot so that no attempt is made to pass the filtering device through an occluded vein. If peripheral caval interruption is not possible, a vena caval clip may be applied intraoperatively. However, large pelvic masses, not uncommon in gynecologic cancer patients, may prevent access. Additional problems with vena caval interruption include migration of the device, complete occlusion of the cava, perforation, and infection. In preoperative cases where the patient cannot have a filter or clip placed, one option is the discontinuation of intravenous UH 1 hour before the perioperative period, with resumption approximately 6 hours after completion of the surgery. Most patients will do well with this technique, but they are still vulnerable to intraoperative PEs. Another pharmacologic option may include the preoperative lysis of the thrombus with thrombolytic agents such as urokinase followed by resumption of standard prophylactic measures. Oral anticoagulation is used after caval interruption, if not contraindicated, to prevent postthrombotic venous stasis of the lower extremity. Therefore, mechanical devices, while reducing perioperative pulmonary emboli, do not obviate the need for long-term anticoagulation. It is vitally important if one is operating on patients who have traveled on long-haul flights that major surgery should be avoided within 48 hours of this flight. NICE guidance on venous thromboembolism in patients undergoing surgery (NICE 2012) states "immobility associated with continuous travel of more than three hours in the four weeks before or after surgery may increase the risk of VTE." For those patients traveling by airplane postoperatively, the relatively new oral preparations of Dabigatran and rivaroxaban, licensed for the prevention of VTE after hip and knee replacement surgery, may be prescribed (Gomez-Outes et al. 2009).

DIAGNOSIS

Given the imperfection of prophylaxis and the high risk of VTE in gynecologic oncology patients, all physicians caring for these women should be familiar with the treatment and diagnosis of VTE including PE. Fewer than one-third of patients with VTE of the lower extremity will present with the classic symptoms of unilateral edema, pain, and venous distension. A positive Homan sign (calf pain with dorsiflexion of the foot) is also unreliable and is seen in less than half of patients with VTE. Calf VTE occurs bilaterally in approximately 40% of cases and is more common on the left (40%) than on the right (20%). Only a high index of suspicion and objective testing can correctly identify patients with VTE.

In high-risk patients with a high baseline prevalence of VTE, sensitive but non-specific tests are useful owing to their high positive predictive value. To exclude disease in these same high-risk patients, repeat testing on subsequent days or more sensitive techniques are needed. Noninvasive diagnostic testing should always be considered before interventional techniques including venography and arteriography. Lower extremity Doppler and real-time two-dimensional ultrasonography scans are fairly sensitive (85%) and specific (>95%) for VTE. If results are positive in high-risk patients, including those with symptoms suggestive of PE, no further testing is indicated and therapy may be initiated. In the past, ventilation–perfusion scans and more recently spiral CT thoracic scanning may be used similarly in patients in whom PE is suspected. If the scan indicates an intermediate or high probability of PE, treatment is usually advisable. In patients at higher risk for hemorrhagic complications, such as during the immediate postoperative period where there is residual tumor, confirmatory tests may be indicated before therapy.

TREATMENT

If there is no contraindication to anticoagulation, therapy should be started as soon as the diagnosis of VTE is made. Outcomes are correlated with the time it takes to achieve therapeutic anticoagulation, so the fastest means available should be employed. LMWH has an advantage over UH in that a single daily dose of approximately 175 units/kg subcutaneously will be therapeutic almost immediately. Unfractionated heparin may require approximately 24 hours and repeated blood testing before becoming therapeutic. Treatment with warfarin can be started once the anticoagulation effect of either heparin is confirmed. With UH, this may be as early as day 1, although 2 to 3 days of therapy may be needed before anticoagulation is achieved. With LMWH, warfarin can be started within a few hours, and definitely on the same day. Either heparin should be continued until the warfarin has achieved an international normalized ratio of 2 to 3. Anticoagulation with warfarin should continue for at least 3 months. Patients with recurrent VTE or persistent precipitating events, e.g., vessel compression by tumor, may need indefinite anticoagulation.

Disseminated cancer and chemotherapy will unavoidably increase the risk of complications from anticoagulation. Cancer patients who have nutritional deficits, organ damage, and unknown metastatic sites are particularly vulnerable. Chemotherapeutic agents alter the metabolism of anticoagulants through their effect on liver and renal function, making dosing more difficult. Chemotherapeutic drugs may also share similar toxicities with anticoagulants and thereby worsen hemorrhagic complications from thrombocytopenia and anemia. For these reasons, treatment of VTE may be neither desired by the patient nor recommended by her physician in all situations.

INFECTION PROPHYLAXIS

Most gynecology units now routinely use antibiotic prophylaxis prior to both minor and major surgery. In the absence of such prophylaxis, abdominal hysterectomy is complicated by infection in up to 14% of patients, and following vaginal hysterectomy, infection rates of up to 38% have been reported (Sweet and Gibbs 1990). This results in much morbidity, increased length of hospital stay, increased prescribing of antibiotics, and a large financial burden. By its very nature, oncological surgery carries greater risks of infection than routine gynecological surgery, owing to the length of the procedures and increased blood loss (Table 1.3).

It is difficult to compare many of the studies on prophylaxis, as diagnosis and antibiotic regimens are not standardized. However, there seems to be general agreement that approximately 50% of infections are prevented in this way and that the potential dangers of increased microbial resistance do not justify withholding prophylaxis. Prophylaxis is thought to work by

Table 1.3 Risk Factors for Postoperative Infection

1	Hospital stay for more than 72 hours before surgery
2	Prior exposure to antimicrobial agents in the immediate preoperative period
3	Morbid obesity
4	Chronic illness, e.g., hypertension, diabetes
5	History of repeated infection
6	Prolonged operative procedure (>3 hr)
7	Blood loss in excess of 1500 mL

reducing, but not eradicating, vaginal flora. The antibiotic used, its dose, and the duration of therapy do not appear to influence results. It is therefore suggested that short courses of antibiotics should be used, involving a maximum of three doses. First-generation cephalosporins, broad-spectrum penicillins, and/or metronidazole are all reasonable choices on grounds of efficacy and cost. Antibiotic prophylaxis should not detract from good surgical technique, with an emphasis on strict asepsis, limitation of trauma, and good hemostasis.

INFECTION CONTROL

There is increasing awareness of the risks of transmission of blood-borne pathogens from surgeon to patient and vice-versa during surgical practice. These risks have been highlighted by the publicity surrounding human immunodeficiency virus (HIV), but are generally greater from other pathogens including hepatitis B virus (HBV). Infection with hepatitis C virus (HCV) also poses a risk of transmission from patient to surgeon. The prevalence of these viral infections varies widely with different populations, and this exerts an influence on the surgeon's risk, as does the number of needlestick (or sharps) injuries sustained and the surgeon's immune status. The risks of transmission of these viruses and their subsequent pathogenicity are discussed below. The necessity for universal precautions in surgical practice need not affect overmuch operator acceptability or cost.

Antenatal anonymous surveys have shown a seroprevalence of HIV in metropolitan areas of the United Kingdom to be as high as 0.26% (Evans et al. 2009). HIV prevalence has increased in the United Kingdom over the last decade, with an estimated 110,000 individuals living with HIV by 2013.

The risk of acquiring HIV from a single-needlestick injury from an infected patient is in the region of 0.10% to 0.36% (Cardo et al. 1997a,b). Pooled data from several prospective studies of healthcare personnel suggest that the average risk of HIV transmission is approximately 0.3% (95% confidence interval, 0.2–0.5) after a percutaneous exposure to HIV-infected blood and approximately 0.09% (95% confidence interval, 0.006–0.5) after a mucous-membrane exposure (Gerberding 2003). However, using mathematical models to predict lifetime risks of acquiring the infection in a population with a low HIV seroprevalence (0.35%), it has been suggested that 0.26% of surgeons would seroconvert during their working lives (Howard 1990). Needlestick injuries pose a significant occupational risk for surgical trainees. A study by Makary et al. (2007) in *The New England Journal of Medicine* found that virtually all surgical residents (99%) had had a needlestick injury by their final year of training, and concluded that needlestick injuries are common among surgeons in training and are often not reported. Improved prevention and reporting strategies are needed to increase occupational safety for surgical providers (Makary et al. 2007).

In December 2001, 57 healthcare workers in the United States had seroconverted to HIV as a result of occupational exposure. Of the adults reported with acquired immune deficiency syndrome (AIDS) in the United States through December 31, 2002, 24,844 had a history of employment in healthcare. These cases represented 5.1% of the 486,826 AIDS cases reported to the Centers for Disease Control and Prevention (CDC) for whom occupational information was known (www.cdc.gov). This website is a valuable resource, particularly with respect to new and ever-changing drug regimens currently in use in the management of blood-borne pathogens. Intact skin and mucous membranes are thought to be effective barriers against HIV. Only a very few cases of transmission via skin contamination are known to have occurred, and these healthcare workers had severe dermatitis and did not observe barrier precautions when exposed to HIV-infected blood (CDC 1987). Aerosol transmission of HIV is not known to occur, and the principal risks are related to injuries sustained from hollow-bore needles, suture needles, and lacerations from other sharp instruments. Infectivity is determined by the volume of the inoculum and the viral load within it: thus, a hollow-bore needlestick injury carries greater risk than injury from a suture needle. Prior to highly active antiretroviral therapy, infection with HIV results in AIDS in 50% of patients over a 12-year period and had a long-term mortality approaching 100%. The situation is now radically different. For HIV seropositive surgeons, further operative practice involving insertion of the fingers into the body cavity is precluded owing to the potential risk of doctor-to-patient transmission: for gynecologic surgeons, this encompasses virtually their entire surgical practice, with the exception of laparoscopic and hysteroscopic procedures.

There is a whole classification related to exposure-prone procedures (EPP) which is categorized into nonexposure-prone (category 0) and exposure (1–3). Category 3 encompasses all open procedures. This classification is available from the UK Department of Health website related to UKAP (United Kingdom Advisory Panel for Health Care Workers infected with blood-borne pathogens). At present there is no vaccine available to prevent infection with HIV. Should needlestick injury occur, the injured area should be squeezed in an attempt to expel any inoculum, and the hands should be thoroughly washed. There is good evidence that after exposure prophylactic zidovudine (azidothymidine [AZT]) reduces transmission by 79%. Most occupational health departments now advise their healthcare workers to commence treatment within 1 hour of injury with multiple therapy which depending on the risk of HIV exposure should either be a two-drug regimen for 4 weeks, or for those at higher risk a three-drug regimen. These used to commonly include zidovudine (AZT), as it is the only drug which has proven to reduce HIV risk following occupational exposure. However, as AZT is often poorly tolerated, newer medications such as tenofovir and emtricitabine are being increasingly utilized instead, mostly in combination with a protease inhibitor.

This type of regimen may well reduce the risks of seroconversion further. In some countries, surgeons with a persistently undetectable viral load (less than 50 copies) may be allowed to return to performing EPPs under occupational health supervision.

Intraoperative transmission of HBV occurs more readily than with HIV, and exposure of skin or mucous membrane to blood from a hepatitis B e antigen (HBeAg) carrier involves a highly significant risk of transmission for those who are not immune (West 1984). The risk of seroconversion following an accidental inoculation with blood from an HBeAg carrier, in the absence of immunity, is up to 30% for susceptible healthcare workers without post-exposure prophylaxis (PEP) or sufficient hepatitis B vaccination (Wicker et al. 2008). Hepatitis B surface antigen (HBsAg) is found in 0.5% to 1% of patients in inner cities and in 0.1% of patients in rural areas and blood donors. Given a needlestick rate of 5% per operation, the risk of acquiring the virus in a surgical lifetime is potentially high. Prior to the introduction of HBV vaccination an estimated 40% of American surgeons became infected at some point in their careers, with 4% becoming carriers. Acute infection with HBV is associated with the development of fulminant hepatitis in approximately 1% of individuals. Carriers may go on to develop chronic liver damage, cirrhosis, or hepatocellular carcinoma, carrying an overall mortality of approximately 40%.

Transmission of HBV from infected healthcare workers to patients is rare but well documented. Welch et al. (1989) reported a case of an infected gynecologist who transmitted HBV to 20 of his patients; the operations carrying greatest risk of infection were hysterectomy (10/42) and caesarean section (10/51). In view of this risk, government guidelines in most countries stipulate that surgeons should be immune to HBV, either through natural immunity or vaccination, the exceptions being staff who fail to respond to the vaccine (5%–10%) and those who are found to be HBsAg positive in the absence of "e" antigenemia (United Kingdom Advisory Group on Hepatitis 2003). In the United Kingdom, the United States, and other countries this is a statutory obligation. Those who fail to respond to vaccination should receive hepatitis B immunoglobulin following needlestick injury where the patient is HBV positive.

HCV, the commonest cause of non-A non-B hepatitis in the developed world, is also known to be spread by blood contamination. Routine screening for antibodies among blood donors in the United Kingdom has shown that 0.05% were seropositive in 2001; many of these were seemingly healthy asymptomatic carriers. However, as many as 85% of injecting drug users may be seropositive. In the United Kingdom, infection with HCV is second only to alcohol as a cause of cirrhosis, chronic liver disease, and hepatocellular carcinoma, although the clinical course in seemingly healthy individuals is unclear.

A recent anonymous seroprevalence study of staff at an inner London teaching hospital reported that infection with HCV was no higher than that previously seen in blood donors. The seroprevalence was no different for workers involved with direct clinical exposure (medical and nursing staff) compared with those at risk of indirect clinical exposure (laboratory and ancillary staff) (Zuckerman et al. 1994). However, these findings should not lead to complacency. From epidemiological data, it would appear that HCV infection is less contagious than HBV, but more so than HIV. The risk of a HCV infection is estimated at between 3 and 10%; it increased tenfold if the source patient has high levels of virus load (Wicker et al. 2008). It would, however, appear that transmission is very rare with solid-bore needles, i.e., almost exclusively follows inoculation with hollow bore needles. Transmission has rarely followed mucous membrane exposure and never via non-intact or intact skin. The possibility of HCV infection should be considered in the event of needlestick injury. Immunization and PEP are not available for those exposed to HCV. Recently, in the United Kingdom the same restrictions have been introduced to healthcare workers infected with HIV and hepatitis C i.e., preclusion from performing exposure-prone procedures. This is not the case in any other country.

PREVENTION OF BLOOD-BORNE INFECTION

Some surgeons have advocated preoperative screening of patients for HIV infection. They argue that patients shown to be infected should be treated as high-risk, while the remaining patients would be labeled as low-risk, with the consequent development of a two-tier infection control policy. However, such an approach is fraught with political, ethical, logistical, and financial implications, and furthermore, wrongly assumes that infected patients can always be identified by serological testing. The universal precautions suggested below are practicable, and effectively minimize the intraoperative infection risk of both surgeon and patient. These precautions are based on the procedure rather than the perceived risk status of the patient. As discussed above, the greatest risk of contracting a blood-borne pathogen is from needlestick injury. Vaginal hysterectomy has been shown to have the highest rate (10%) of needlestick injury of any surgical procedure (Tokars et al. 1991). Glove puncture has been used as a measure of skin contamination and a reflection of needlestick injury; the highest rate of glove puncture reported in any surgical procedure was 55% at caesarean section. Double gloving has shown a sixfold diminution in inner glove puncture rate, and anecdotally appears to result in a reduction in needlestick injury, but it is uncomfortable, particularly during protracted procedures, making it unsuitable for many gynecologic

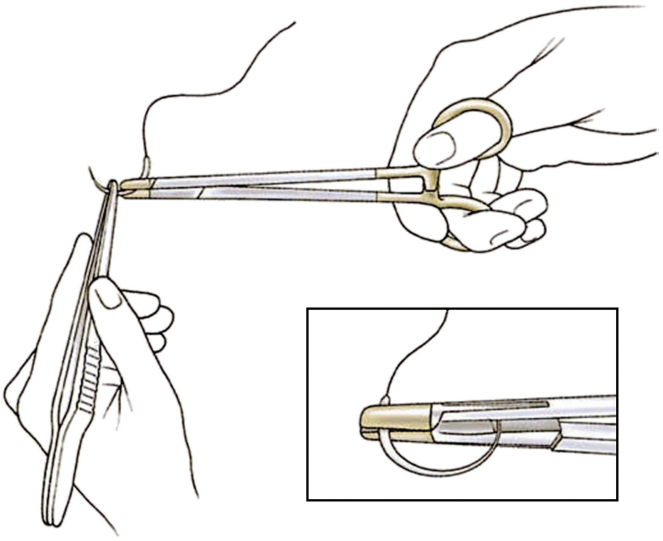

Figure 1.2 Safety needle holder.

Table 1.4 Risk Factors for Transmission of Blood-Borne Pathogens during Surgical Practice

1	Prolonged surgical procedure
2	Heavy blood loss
3	Operating within a confined space, e.g., pelvis or vagina
4	Poor lighting
5	Guiding the needle by feel

Table 1.5 Simple Precautions Available to Reduce Needlestick Injury

1	Blunt-tipped needles: available from Davis & Geck (Protec Point) and Ethicon (Ethiguard needle)
2	Staple guns for skin closure: available from Autosuture and Ethicon Endosurgery
3	Staples for bowel anastomosis: available from Autosuture and Ethicon Endosurgery
4	Spectacles/protective eyewear: blood-borne pathogens have, however, only been shown to be transmitted very rarely and usually only in the presence of gross ocular contamination
5	Magnet for picking up sharps
6	Hands-free disposable sharp boxes for needles and blades
7	Blunt towel clips
8	Self-adhesive drapes

oncological operations. Blunt-tipped needles, such as the Protec Point (Davis & Geck, Gosport, United Kingdom) and Ethiguard (Ethicon, Edinburgh, United Kingdom), appear to reduce the rate of glove puncture, and one of the authors (JRS) has never sustained a needlestick injury in 8 years of continuously using these needles. The newer needles are capable of penetrating the majority of tissues including uterine muscle, vaginal vault, cervix, peritoneum, and rectus sheath. They are unsuitable for bowel and bladder surgery and do not penetrate skin, but they have been used subcutaneously for abdominal wound closure. Abdominal skin closure can also be safely undertaken with the use of staples. This is particularly important since it has been shown that 5% of glove punctures occurred during this stage of the procedure. Just under half of punctures occur in the right hand—a surprising finding considering that most surgeons are right-handed and therefore grasp the needle holder with the dominant hand. Injury appears to occur during knot tying, and a safety needle holder with provision for guarding the needle tip at this stage and when returning the needle to the scrub nurse is now available (Thomas et al. 1995) (Figure 1.2). The use of a kidney dish for passing scalpels between staff should also be encouraged, as should safe needle and blade disposal in hands-free surgical sharps boxes. Blades or needles that have fallen on the floor should be retrieved with a magnet prior to disposal. Blunt towel clips are also available to prevent injury while draping. Reusable self-adhesive drapes are available, as are disposable self-adhesive drapes with a surrounding bag to prevent gross contamination.

Skin and mucous membrane contamination should be avoided by the use of masks and waterproof gowns. Glasses or other protective eyewear should be worn to prevent contamination by facial splashes of blood and other body fluids.

The risks and safety measures discussed above are summarized in Tables 1.4 and 1.5. Table 1.4 demonstrates that oncological surgery carries the greatest risk. However, the simple and relatively cheap procedures and precautions suggested in Table 1.5 can reduce the risk for both surgeon and patient to extremely low levels.

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2 Preoperative workup

Jessica Thomes-Pepin and Chris Stephenson

INTRODUCTION

Surgical planning for the patient with a gynecologic malignancy begins with a detailed assessment of perioperative risk determined by pre-existing medical comorbidities. Reducing perioperative-associated complications and improving outcomes remains a prudent goal in procedural preparation.

Additional considerations in surgical planning include discussions with the patient regarding postoperative expectations, the need for blood products, the need for subsequent additional therapy including surgical procedures or chemotherapy, the possibility for ostomy or placement of other tubes and/or catheters, potential changes in sexual function, and the effect of the procedure on quality of life.

The more informed a patient can be regarding expectations surrounding surgical management, the more likely they are to make sound judgment regarding therapy and to be satisfied with their overall care. The following recommendations help assess surgical "fitness" by organ system. Highlights are indicated in a box, as above.

ASSESSMENT OF PERIOPERATIVE CARDIAC RISK

The most treatable cause of morbidity and mortality associated with noncardiac surgery remains perioperative cardiovascular complications. Nearly one-third of all patients undergoing major elective surgery have at least one major cardiac risk factor, with the greatest risk of perioperative death stemming from associated cardiac stress (Mangano 1990).

Acute myocardial infarction (MI) comprises 50% of all perioperative cardiovascular complications, which most commonly occur within the first three days after surgery (Ashton et al. 1993).

A postoperative MI carries a 28-fold increase in risk of cardiovascular complications within the first 6 months following surgery; including a 40% to 70% increased risk of death (Shah et al. 1990). The 2014 ACC/AHA perioperative cardiac risk guidelines determine preoperative risk according to patient and procedural factors applied within an evidence-based algorithm (Fleisher et al. 2008). Preoperative cardiac assessment allows the determination of fitness for surgery, minimizes major adverse cardiac events (MACE) in the postoperative period, and identifies those at risk for long-term adverse outcomes.

2014 ACC/AHA PERIOPERATIVE CARDIAC RISK GUIDELINES

Step 1: Determine the Urgent or Emergent Nature of the Procedure

Emergent (<6 hours) or urgent (6–24 hours) procedures allow for limited to no clinical evaluation. The risk of cardiovascular complications in these procedures is increased two- to fivefold in comparison to elective procedures (Goldman et al. 1977). This prompts the operative team to employ more aggressive perioperative surveillance and management. A procedure performed on an elective basis allows further evaluation and assessment, and possibly treatment of active cardiac conditions, lowering the overall risk of MACE. The majority of oncologic procedures fall into the time-sensitive category (<1–6 weeks), allowing for evaluation and further assessment without significant time for intervention.

Step 2: Determine the Presence of Active Cardiac Disease or Active Clinical Risk Factors of Cardiac Disease

There remains a persistent underestimation of cardiac disease in women evaluated preoperatively. In patients with established cardiovascular disease, preoperative assessment must include eliciting any recent change in symptoms including shortness of breath, palpitations, fatigue, or chest pain. Unstable angina, MI, significant arrhythmias, cardiomyopathy, or severe cardiac valvular disease all increase the risk of MACE. MACE after noncardiac surgery is often associated with prior coronary artery disease (CAD), and the timing of a recent MI impacts perioperative morbidity and mortality (Fleisher et al. 2008).

In a retrospective chart analysis, the incidence of postoperative MI decreased as the length of time from MI to procedure increased (0–30 days, 32.8%; 31–60 days, 18.7%; 61–90 days, 8.4%; 91–180 days, 5.9%) (Livhits et al. 2011).

A recent MI occurring within 6 months of noncardiac surgery has been found to be an independent risk factor for perioperative stroke and associated with an eightfold increase in perioperative mortality (Mashour et al. 2011). Obviously, most cancer patients cannot wait 6 months for surgery, however a delay to beyond 30 days may be acceptable in certain circumstances. Age, smoking, hyperlipidemia, and diabetes mellitus are important historical factors that portend further investigation.

Patients with clinical heart failure (HF) or history of HF are at significant risk for perioperative complications (Detsky et al. 1986). Risk-adjusted 30-day mortality and readmission rates in patients undergoing major noncardiac surgery was 50% to 100% higher in patients with HF than in elderly controls without a history of CAD or HF (Hammill et al. 2008).

Decompensated HF confers the highest perioperative risk, while severely decreased (<30%) left ventricular ejection fraction (LVEF) independently contributes to perioperative morbidity and mortality (Healy et al. 2010).

It is recommended that patients with clinically suspected moderate or greater degrees of valvular stenosis or regurgitation undergo preoperative echocardiography if not performed within the last year or if there has been a change in clinical status or the physical examination since the last evaluation (Douglas et al. 2011).

Preoperative recommendations regarding non-ischemic cardiomyopathies must be made in conjunction with the patient's cardiologist or a gynecological oncologist with a thorough understanding of the pathophysiology of the cardiomyopathy who can integrate assessment and management of the underlying process and associated HF (Fleisher et al. 2015). For those patients requiring intervention, perioperative risk may be lowered if performed prior to elective noncardiac surgery (Nishimura et al. 2014). There are a paucity of data regarding cardiac arrhythmias and conduction disorders regarding true contribution to perioperative risk; however, their presence within the preoperative setting warrants further investigation. Patients with an implantable electronic device (IED) should be managed in conjunction with the clinician following the patient regarding the device and underlying cardiac disease. If feasible, a patient with pulmonary hypertension should undergo evaluation by a specialist prior to proceeding with surgery, and continue all chronic pulmonary vascular targeted therapy unless contraindicated (Fleisher et al. 2015).

Step 3: Calculation of Risk to Determine Perioperative Morbidity

In the 2007 ACC/AHA guidelines, the committee separated clinical risk factors into major, intermediate, and minor categories (Eagle et al. 2002) (Table 2.1). The presence of one or more active cardiac conditions with major clinical risk warrants further investigation prior to proceeding with surgery. In conjunction with estimation of procedural risk, the specific combined incidence of cardiac death and nonfatal MI helps determine whether further preoperative cardiac testing is indicated (Tables 2.2A and 2.2B). The 2014 ACC/AHA clinical practice guidelines (CPG) recommend use of a validated risk-prediction tool to predict the risk of perioperative MACE in patients undergoing noncardiac surgery. Different calculators include the Revised Cardiac Risk Index (RCRI), the American College of Surgeons National Surgical Quality Improvement Program (NSQIP), Myocardial Infarction and Cardiac Arrest (MICA), and the American College of Surgeons NSQIP Surgical Risk Calculator (Cohen et al. 2013, Gupta et al. 2011, Lee et al. 1999) For patients with a low risk of perioperative MACE, further testing is not recommended prior to proceeding with the planned procedure.(Schein et al. 2000)

Step 4: Determine the Patient's Functional Capacity, or their Ability to Perform Common Daily Tasks

Functional capacity is measured in METS (metabolic equivalents), and correlates with oxygen demands in stress testing (Hlatky et al. 1989) (Table 2.3).

Functional status is a reliable predictor of perioperative and long-term cardiac events (Fleisher et al. 2015). A high functional status usually requires no further testing.

Table 2.1 The Presence of One or More Active Cardiac Conditions with Major Clinical Risk Warrants Further Investigation Prior to Proceeding with Surgery

Major cardiac risk factors	Unstable coronary artery syndromes
	Unstable or severe angina
	Recent myocardial ischemia
	Uncertain timing of historic MI-Q waves on EKG
	Acute MI: acute event 7 days or prior
	Recent MI: >7 days or ≤1 month prior
	Decompensated heart failure
	Significant arrhythmias
	Severe valvular disease
Intermediate cardiac risk factors	History of heart failure
	History of compensated heart disease or prior heart failure
	History of cerebrovascular disease
	Diabetes mellitus
	Renal insufficiency
Minor cardiac risk factors	Abnormal EKG: LBBB, LVH, ST abnormality
	Rhythm other than sinus
	Uncontrolled systemic hypertension

Abbreviations: MI, myocardial infarction; EKG, electrocardiogram; LBBB, left bundle branch block; LVH, left ventricular hypertrophy.
Sources: Adapted from Freeman WK, Gibbons RJ, *Mayo Clin Proc* **84**(1):79–90, 2009; Flleisher et al. (2007), Eagle KA, Berger PB, Calkins H, et al., *Anesth Analg* **94**:1052–64, 2002.

In patients without a recent exercise test, functional status can be estimated from the ability to perform activities of daily living (Reilly et al. 1999). Functional capacity is classified as excellent (10), good (7−10), moderate (4–6), poor (4 or less), or unknown. Perioperative cardiac and long-term risks are increased in patients unable to perform 4 METs of work during daily activities (Fleisher et al. 2015). In patients with poor or unknown functional capacity, the number of active clinical risk factors should guide the need for further testing. The 2014 ACC/AHA CPG provides a preoperative algorithm for guidance on perioperative management to minimize associated risk on the basis of available evidence and expert opinion (Figure 2.1).

Step 5: Supplemental Preoperative Evaluation

Supplemental testing allows the clinician to obtain prognostic information, further guiding therapy and perioperative management. A preoperative electrocardiogram (ECG) within 30 days of surgery is useful in patients with established coronary heart disease, providing a useful baseline standard to measure changes postoperatively (Beattie et al. 2006).

An ECG is not useful in asymptomatic patients undergoing low-risk surgical procedures (Liu et al. 2002, Turnbull and Buck, 1987).

Left ventricular (LV) function should be preoperatively evaluated in patients with dyspnea of unknown origin, patients with HF with worsening dyspnea, other changes in clinical status, or stable patients with a history of LV dysfunction and no assessment within a year (Healy et al. 2010).

Table 2.2 A) Procedural-Based Risk

High risk (5%)	Advanced upper abdominal extensive debulking
	Segmental liver resection
	HIPEC
Intermediate risk (1%–5%)	Intraperitoneal and intrathoracic surgery
	Head and neck surgery
	Orthopedic surgery
	Simple and radical hysterectomy
	Robotic hysterectomy
	Extensive MIS debulking
Low risk (<1%)	Simple endoscopic procedures (IP port)
	Superficial procedures
	Wide local excision ambulatory surgery
	Vascular port placements

Source: Adapted from Fleisher LA, Beckman JA, Brown KA, et al., *Anesth Analg* **106**:685–712, 2008.

Table 2.2 B) Preoperative Cardiac Evaluation Algorithm

Without known cardiac issue	Low-risk procedure	Proceed with planned procedure
	Intermediate- or high-risk procedure	Determine functional capacity, proceed with planned procedure if ≥4 METs without symptoms
Low or unknown functional	Intermediate- or high-risk procedure	Consider cardiac testing if it will change capacity management Proceed with heart rate control or consider noninvasive testing if it will change management

Source: Adapted from Fleisher LA et al., *J Am Coll Cardiol* **50**:1707–32, 2007.

Table 2.3 Metabolic Equivalents

I.	Eat, dress, use the toilet without assistance
II.	Walk indoors and around the house without assistance
III.	Walk a block or two on level ground at 2–3 mph without assistance
IV.	Perform light work around the house including dusting or washing dishes
V.	Climb a flight of stairs or walk up a hill
VI.	Walk on level ground at 4 mph
VII–X.	Run a short distance
	Perform heavy housework including scrubbing floor or lifting or moving heavy furniture
	Participate in moderate recreational activity including golf, bowling, dancing, tennis
	Perform strenuous sport activity like running, swimming
	Participate in singles tennis, football, basketball, and skiing

Sources: Adapted from Hlatky MA, Boineau RE, Higginbotham MB, et al., *Am J Cardiol* **64**:651–4, 1989; Fletcher GF, Balady G, Froelicher VF, et al., *Circulation* **91**:580–615, 1995; Fleisher LA, Beckman JA, Brown KA, et al., *Anesth Analg* **106**:685–712, 2008.

For patients with elevated risk who have an excellent functional capacity (>10 METs), and possibly moderate to good (>4 to 10 METs) functional capacity, it is reasonable to forego further testing and proceed with surgery (Carliner et al. 1985). For patients with elevated risk and poor (<4 METs) or unknown functional capacity, it may be reasonable to perform exercise testing with cardiac imaging or noninvasive pharmacologic stress testing to assess for myocardial ischemia if it will change management (Das et al. 2000). Perioperative cardiac risk is directly linked to the extent of jeopardized viable myocardium identified by stress cardiac imaging (Beattie et al. 2006). Cardiopulmonary exercise testing may be considered for patients undergoing elevated risk procedures where functional capacity is unknown (Snowden et al. 2013).

PERIOPERATIVE THERAPY

In patients where preoperative risk stratification recommends revascularization prior to surgery, proceeding with therapy should be dictated according to existing clinical practice guidelines (Hillis et al. 2012, Levine et al. 2011). There are no randomized controlled trials to support routine coronary revascularization prior to noncardiac surgery exclusively to reduce perioperative cardiac events (McFalls et al. 2004).

In patients who have had prior percutaneous coronary intervention (PCI), elective noncardiac surgery should be delayed 14 days after balloon angioplasty, 30 days following bare metal stent (BMS) placement, and 365 days following drug-eluding stent (DES) placement (Berger et al. 2010, Nuttall et al. 2008, van Kuijk et al. 2009).

In situations where noncardiac surgery is necessary, a consensus decision regarding the relative risks of surgery and antiplatelet therapy can be helpful.

Patients with implantable cardioverter defibrillators (ICDs) who have inactivated programming preoperatively should have continuous cardiac monitoring utilized intraoperatively with external defibrillation equipment readily available (Fleisher et al. 2015).

PERIOPERATIVE MEDICAL MANAGEMENT

Several randomized control trials have suggested perioperative beta-blockade reduces cardiac events in high-risk patients during noncardiac procedures. However, other studies, including a