Acute Care and Surgical Risk Assessment

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4.1 Introduction

Colorectal cancer presents as an emergency in about 15–20% of the patients with colon cancer and about 5% of those with rectal cancer [1–4] with regional variations and some reporting emergency presentations as high as 33% [5]. An oncologic emergency is defined as an "acute, potentially life-threatening condition in a cancer patient that has developed as a result of malignant disease or its treatment" [6].

It is important to meet the acutely ill patient with colorectal cancer with optimal knowledge due to associated high perioperative mortality of up to 20% and morbidity of 40–50% [1–3]. Colorectal cancer usually presents in an emergent setting through one of either three ways, *obstruction*, *perforation*, or *hemorrhage*, with prevalence from high to low in mentioned order [2]. Acute obstruction occurs in 8–29% [2, 5, 6] and stands for 77–85% of emergency colorectal cancer operations [2, 5]. Emergency presentation may also occur during either neoadjuvant or palliative treatment, with some drugs such as bevacizumab (an anti-angiogenesis inhibitor) reported to predispose to perforations. For the sake of clarity, this chapter will discuss the patient with colorectal cancer that presents as an emergency.

Conflict of interest: None declared.

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N. de'Angelis et al. (eds.), *Emergency Surgical Management of Colorectal Cancer*,
Hot Topics in Acute Care Surgery and Trauma,
https://doi.org/10.1007/978-3-030-06225-5_4

Once it has been established the patient's symptoms is caused by an acute colorectal condition, acute care should be initiated. The clinician has to decide together with the patient what will be the next steps of treatment adjusted to risk and perceived benefit. In this chapter, we will highlight important aspects of the acute care and surgical risk assessment to better manage this patient group presenting as an emergency.

4.2 Acute Care and Emergency Assessment

Colorectal cancer presenting as an emergency imposes multiple challenges. As 60% of these patients are ≥70 years [7], they usually have comorbidities, which both aggravate their serious condition and may challenge the effect of treatment. The patients may often present with a locally advanced or disseminated disease associated with deranged physiology and will hence tolerate surgery less well [3, 4, 6, 8–10]. Typically, patients often present late at evening or night, when more junior surgeons are on call and less experienced staff available.

A structured approach (Fig. 4.1) to this complicated patient group is advised for better management. In some cases, despite the fact that patients experience symptoms early, they have a delay in contact with the healthcare system. These patients are usually older with dementia, come from low socioeconomic background, or

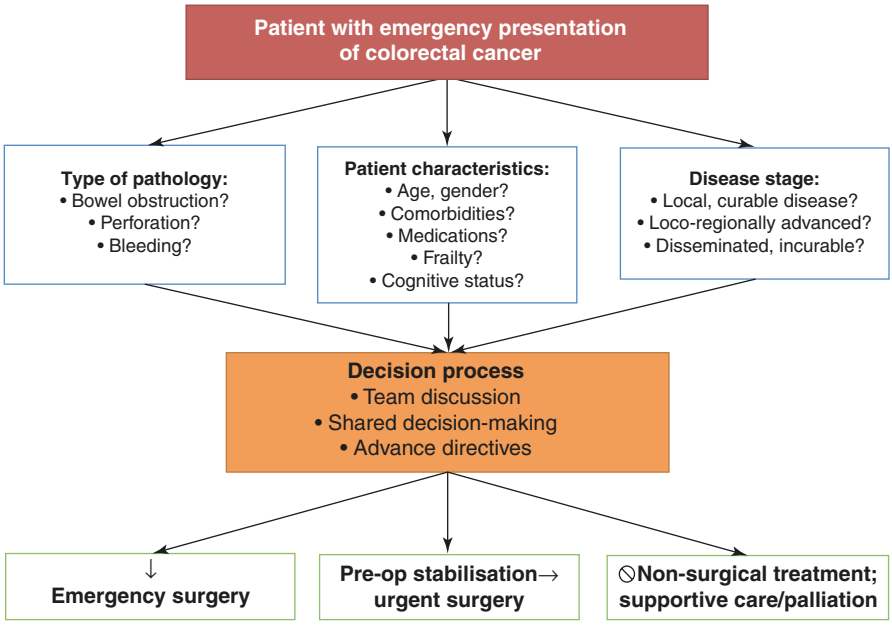

Fig. 4.1 Structured approach to the patient with acute presentation of colorectal cancer

have non-Caucasian background [1]. A few patients also have an extreme hospital anxiety and thus postpone contact with health care.

Acute care assessment includes to diagnose the **pathology causing the acute condition**, i.e., obstruction, perforation or hemorrhage, the *patient's characteristics* in terms of acute changes of physiology (sepsis, electrolyte and fluid derangements, anemia) and preexisting comorbidities, use of medications and cognitive function, and *stage of cancer disease*, i.e., locoregional or systemic disease. Moreover, as patients may present at various stations of their disease trajectory, and with differing perspectives for their remaining life time, the doctor in charge should try to identify the patient's preferences with regard to goals and intensity of further treatment. Thus, aims for cure or palliation should be set out early: limitations to use of resources and organ support and, if any, limitations to resuscitation or advanced organ support if required during the course of management (Fig. 4.2).

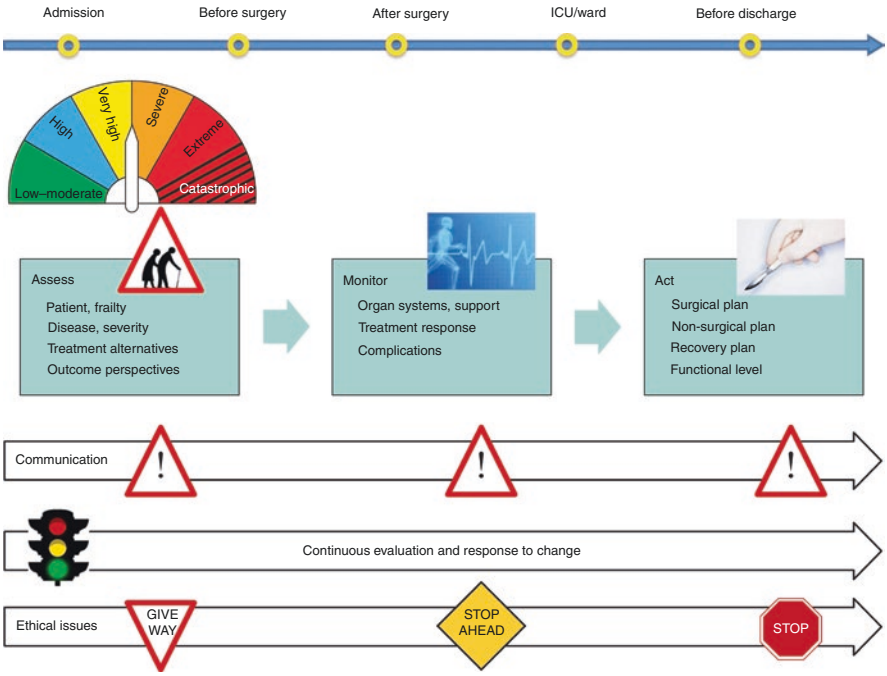

Fig. 4.2 Creating a road map in the pathway of care during emergency surgery. Caring for all, but particular the geriatric patient with a surgical emergency is complex and needs to be tailored to the individual based on associated comorbidity and frailty, disease severity, treatment alternatives, and the wishes of the patient. Continued assessment of interventions and effect, timely and repeated communication, and cautious reflection on aspects of care should be incorporated into decision-making. ICU, intensive care unit. Reproduced with permission from John Wiley [15] Desserud KF, Veen T, Søreide K. Emergency general surgery in the geriatric patient. Br J Surg 2016;103(2):e52–61

4.2.1 Clinical Assessment

One of the first challenges is to determine the condition's degree of emergency. The first priority is to assess if the patient needs immediate surgery or if time allows for optimizing the patient for surgery within the next 24–72 h. The findings of generalized peritonitis combined with signs of systemic inflammatory response (sepsis) indicate the need for urgent surgery, while patients with signs of bowel obstruction usually profit from appropriate fluid and electrolyte replacement and diagnostic imaging. Most patients with hemorrhage from a colorectal cancer can be stabilized with blood transfusions and correction of coagulation disorders and prepared for endoscopic diagnosis and treatment.

In order to achieve a rapid and comprehensive assessment of the emergency presentation of a colorectal cancer, a proper clinical evaluation based on symptoms and physical examination has to be supplemented with biochemical blood analyses, blood typing, and radiological imaging. A full contrast-enhanced computerized tomography imaging of the abdomen and chest should be obtained whenever possible, as this will provide fast and highly reliable information on the pathological condition of the acute illness, as well as the stage of cancer disease. This information is essential to determine a treatment plan.

4.2.2 Type of Acute Presentation

Obstruction is the most frequent acute presentation [2, 5, 6, 11]. In contrast to small bowel obstruction, large bowel obstruction develops over longer time and therefore rarely presents like a fulminant small bowel obstruction with caliber leap. Therefore, the need of immediate surgery is far less frequent, and focus should be on stabilizing the patient and plan the next step of treatment [11]. Surgical treatment depends on the localization of the cancer and the stage of disease and is described in other chapters in this book.

Perforation is the less common but a far more serious acute presentation of colorectal cancer [11]. The cecum is the most frequent site of perforation due to a distal bowel obstruction: increased intraluminal pressure and tension lead to compromised microcirculation of the cecum (according to La Place's law) and thus result in necrosis of the bowel wall [2, 5, 6]. Tenderness and pain in the right lower quadrant, palpation of a dilated cecum, and a diameter of 10 cm or above on imaging should increase the suspicion of imminent bowel perforation. In some cases, a CT scan will reveal intramural gas in the cecal wall as a sign of ischemia and necrosis. In this case, urgent surgery should be considered. However, when the ileocecal valve is insufficient, the small intestines will absorb the increased pressure and fluid contents of the colon, and dilated small bowel segments are seen on imaging studies. In some cases, the perforation can be contained with limited contamination or abscess formation. These patients can initially be treated with antibiotics and drainage before final surgical treatment [2, 5, 11].

Acute hemorrhage is the least common acute presentation. In contrast to chronic occult blood loss due to colorectal cancer, patients with macroscopic hemorrhage from the colon usually present with dark red bloody discharge and seldom with melena as seen in upper gastrointestinal bleeding. Most patients with acute bright-red bloody discharge are diagnosed with rectal cancer. However, bleeding from colorectal cancer rarely induces hemorrhagic shock as seen in bleeding from the upper gastrointestinal tract.

4.2.3 Staging

Consideration of the stage of the cancer is essential for planning. Colorectal cancer emergencies may be due to either localized disease (e.g., a small local, effectively obstructing tumor localized in the large bowel), locally advanced disease that affects other organs, or in the setting of disseminated, and often incurable disease if metastases at multiple sites. Accurate knowledge of stage is an important backstage of treatment decisions, as stage of disease is the most important prognostic factor for long-term outcome for the patient. If liver-alone metastases are present, the potential for a curative goal of surgery should always be entertained. Information of stage is vital to assess where the patient is in the trajectory of cancer disease course, i.e., curable or a non-curable state, or advanced disease with short life expectance or with likely controllable (but not curable) disease with longer life expectancy. Together with other important factors such as the patient's own perspectives and wishes for remaining lifetime, the planned course of action needs to be discussed with patients' preferences incorporated, whenever possible. In this context, empathetic and clear communication with the patient as well as the patient's surrogates will be crucial for a satisfactory course of diagnosis, treatment, and outcome of acutely ill patients with colorectal cancer.

4.2.4 Patient-Related Factors

Aging is caused by accumulation of damaged genetic material by extrinsic (radiation, diet) and intrinsic (free radicals) factors [12]. Such changes over time determine the physiological reserves of the patient in terms of frailty, sarcopenia, anemia, poor nutritional status, and reduced immune system [12]. The degree of biological aging varies between patients and determines physiological reserve, response to insult, and ability to recover from stress. Age as a pure numeric parameter is therefore not an absolute factor as such for surgical or other treatment, but should be seen in the context of biological age [5, 7, 8]. The patient may present with various degrees of the cancer cachexia syndrome, i.e., the loss of protein mass due to metabolic changes induced by often advanced cancer disease [13, 14]. Thus, age and body weight may serve as proxy surrogate markers for patient risk and other comorbidities.

4.2.5 Comorbidity

Comorbidities are strong predictors of mortality [15]. In patients over 70 years with multiple comorbidities, mortality can be higher than 50% and over 90% in patients above 90 years [15]. Multiple studies have shown that high age, emergency surgery, sepsis, frailty, and high ASA score are associated with increased mortality [15].

Cardiovascular and respiratory diseases are important to consider. Patients with congestive heart failure or previous heart attack are more prone to adverse effects of hypovolemia and anemia due to limited cardiac output and are at the same time exposed for the risk of resuscitation fluid overload. The NYHA classification of daily function, e.g., class III or IV, can quickly give an idea of the heart condition and may be supplied by echocardiography.

Assessment of hydration status is particularly important before anesthesia and should be done in close cooperation with the anesthesiologist [3]. When the patient is given general anesthesia and muscle relaxation, the body is in a state of systemic vasodilation. Changes of the intraperitoneal pressure, either decrease in open or increase in laparoscopic surgery, decrease venous return to the heart and consequently reduce cardiac output. In worst case this can lead to serious hypovolemia and cardiac arrest before the surgery has started [16]. Therefore, it is important to rehydrate and replenish circulating volume or blood losses before surgery whenever possible with crystalloid fluids or blood transfusion. If the patient has electrolyte imbalances, one can choose fluid resuscitation with 0.9% saline with/without added electrolytes. If this is not sufficient, adding vasopressors, such as dopamine and norepinephrine, is indicated [15, 17]. It is important to remember that a geriatric patient might be in shock even with a systolic blood pressure of 110 mmHg due to their reduced functional capacity [15]. In contrast, over resuscitation with colloids increases blood loss by diluting clotting factors and disturbs hemostasis [16, 18].

Underlying *pulmonary diseases* and reduced compliance of the chest wall and the lungs contribute to worsen hypoxia in the already critically ill patient [15]. Cellular hypoxia causes cellular dysfunction which can lead to systemic inflammatory response syndrome and organ dysfunction. However, it is important to keep in mind that hypoxia is not always caused by respiratory or circulatory failure, but may be caused by a distended abdomen due to bowel obstruction or peritonitis that presses the diaphragm upwards and reduces the volume of the thoracic cavity. Increased abdominal pressure can also impair the venous return to the heart. In this case, a nasogastric tube is indicated to decompress the gastrointestinal tract as an effective measure to restore physiology [16].

Acute *renal injury* is a potentially life-threatening condition in the critically ill patient [19]. Sepsis and nephrotoxic drugs stand for 50% and 25% of causes of acute kidney failure in intensive care units. Major surgery, hypovolemia, and nephrotoxic radiological contrast agents are common causes in the acute colorectal patient. Renal function is measured by serum creatinine levels and urinary output [19]. Acute renal failure inhibits secretion of acidosis and bicarbonate production (i.e., metabolic acidosis), which affects cardiac contractility and electrical

conduction, reduces venous vasoconstriction, increases total peripheral vascular resistance, and further impairs oxygen delivery [19]. This has serious consequences in the acute colorectal patient and challenges anesthesia. Early resuscitation and treating sepsis is therefore crucial to prevent or reverse acute renal failure [19].

Electrolyte disturbances are common and often related to renal failure. In example, severe hypo- or hyperpotassemia can cause cardiac abnormalities and in worst case give arrhythmias that lead to cardiac arrest [19]. Potassium abnormalities also interfere with neuromuscular transmission. Suxamethonium (Curacit) is a muscle relaxant given under introduction of anesthesia and can worsen hyperpotassemia. It is therefore important to correct electrolyte imbalances preoperatively. Insulin-glucose infusion induces shift of the extracellular potassium into the intracellular space, and thus decreases the adverse effect of hyperpotassemia on the heart and muscular system [19]. Alternatively, sodium bicarbonate infusion causes alkalosis, which leads to release of intracellular hydrogen molecules into the blood in exchange with extracellular potassium [19].

Anemia combined with iron deficiency is common and is associated with increased mortality, thus it is a poor prognostic factor [20]. Particularly elderly patients with coronary artery disease are at risk. However, correcting anemia by blood transfusion should be restricted to patients with severe anemia (i.e., hemoglobin <8 mg/L) or clear symptoms of anemia, as multiple studies have shown that blood transfusion is associated with reduced survival of cancer, increased recurrence rate and postoperative infections [3, 16, 20]. Other adverse side effects of blood transfusion include transmission of blood-borne pathogens and transfusion-related acute lung injury (TRALI), a syndrome which causes acute hypoxemia and noncardiogenic pulmonary edema [20].

Hematological disorders are important to consider preoperatively. If the patient suffers from von Willebrand factor (vWF) disease, hemophilia types A or B, or idiopathic thrombocytopenic purpura (ITP), a hematologist should be consulted. Desmopressin is administered to increase vWF; FVIII or factor IX is administered in cases of hemophilia. For patients with ITP, high-dose corticosteroids and intravenous immunoglobulins are recommended [20, 21]. Surgery causes a thrombogenic stress response. Adequate anticoagulation, currently given as low fragment heparin, is important to prevent thromboembolic complications such as deep venous thrombosis or lung emboli.

Frailty is a consequence of age-related decrease in physiological reserve and resistance to stress and a common condition in the acute care setting. It is estimated that 6–15% of the elderly patient group are frail [8]. It is characterized by a distinct phenotype consisting of minimum three of the five following traits: unintentional weight loss, self-reported fatigue, diminished physical activity, impairment of grip strength, and reduced gait speed [4, 8, 15]. Frailty increases the patient's individual risk of disease-related mortality, falls, institutionalization, and hospitalization [8, 15]. A comprehensive geriatric assessment that is often used in research and in elective patients is too comprehensive for use in the acute care [7, 15, 22]. While frailty is strongly associated with poor outcome, there is currently no universal agreed definition for its assessment in the emergency setting.

Malnutrition due to reduced caloric and protein intake is common in elderly patients over 70 years of age and is considered as a marker of frailty because many malnourished patients also present with altered cognition, impaired mobility, and deranged quality of life [8]. A malnourished patient with emergent colorectal disease is more prone to adverse complications after surgery, such as anastomotic leak, wound infection, respiratory infection, and longer hospitalization due to delayed recovery [8, 23]. In contrary to the cancer cachexia syndrome, the effects of malnutrition can be reversed by nutritional support, which is obviously irrelevant in the acute setting. On the other hand, obesity also imposes challenges by increased risk of atelectasis and respiratory failure, thus increasing complication rate [24].

4.2.6 Medications

A complete list of all medications is of great importance for assessment of the acute colorectal cancer patient, as most drugs may cause both known and unknown adverse effects and interactions.

Anticoagulant and antiplatelet medications can cause bleeding that may be difficult to manage. Knowledge of these types of medications are important before performing surgery to know how to counteract their effects (Table 4.1). The traditionally most used drugs, acetylsalic acid and warfarine, are increasingly replaced by novel types of anticoagulants.

Using corticosteroids for more than 30 days prior to surgery and in doses higher than 20 mg/day induces immune suppression and reduced collagen formation and increases the risk of impaired wound healing, anastomosis leakage, and postoperative infections [23].

Angiotensin-converting enzyme inhibitors can during anesthesia mask hypovolemia and contribute to acute kidney injury.

Nonsteroidal anti-inflammatory drugs have adverse effects on the heart, kidneys, and lungs. They can also cause perforation of bowel.

In patients with vascular and heart disorders, beta-blockers should not be discontinued during surgery [17].

Table 4.1 Antiplatelet and anticoagulant medications with description of their effect and available antidote

Medication	Effect	Antidote
Acetylsalicylic acid	Inhibits platelet aggreagation	None, platelet transfusion can be tried
Clopidogrel	Inhibits platelet activation	None, platelet transfusion can be tried
Heparin	Creates complex with antithrombin III, inhibits clotting factors IXa, Xa, Xia, XIIa	Protamine sulfate
Fondaparinux (Arixtra)	Indirect factor Xa inhibitor	None
Rivaroxaban (Xarelto), Apixaban (Eliquis)	Direct factor Xa inhibitor	None
Dabigatran (Pradaxa)	Direct thrombin inhibitor	Praxbind

4.2.7 Cognitive Function

The cognitive function of the patient is an important factor in several aspects. First, it is the base for meaningful communication and shared decision-making. Secondly, preexisting dementia is often related to reduced life expectancy and may have severe impact on decisions regarding the intensity of treatment to be chosen. Thirdly, normal premorbid cognitive function may be compromised by the acute illness. When cognitive function is impaired, it is prudent to involve the patient's family caregivers or surrogates [15]. In this context, it is also highly important to formulate advanced directives and to discuss the patient's preferences with regard to actions to be taken when adverse events occur [15]. In this context, complete staging of the cancer disease is indispensable prognostic knowledge. The presence of widely disseminated disease should initiate contact with the palliative multidisciplinary team whenever possible to preserve best possible quality of life during the remaining lifetime of the patient and for coping of the family with the loss of their beloved one.

4.2.8 Preoperative Stabilization

Most patients who do not require immediate surgery will profit from stabilization on an intensive or high-dependency care unit (described in the respective chapters). Here we briefly mention challenges in the intensive care unit, since many of the patients are in demand of advanced resuscitation. This part of the disease trajectory has to be done with close cooperation between the surgeon and the intensivists (Fig. 4.2). It is important to remember that the aim is not complete resuscitation, but to improve the patient's physiology to better cope with the emergent state and planned surgery. In the emergency setting, studies show that complete resuscitation in favor of delaying surgery does not improve perioperative mortality nor 5-year survival [3].

4.3 Surgical Risk Assessment

At emergent presentation, the perioperative mortality of colorectal cancer is reported up to 20% and morbidity of 40–50% [1–3, 10], as compared to approximately 3% in elective and 18% in elderly patients [7, 9, 25]. Perioperative mortality consists of surgical complications and those associated to the condition of the critically ill patient.

Surgical risk assessment depends on a combination of knowledge of clinical information of the individual patient, supplied by surgeons' sound knowledge of relevant studies in the literature and personal experience. Inevitably, this results in a subjective assessment of the patient. Therefore, sound discussions based on good collegial relationship are encouraged as they will contribute to more favorable patient outcomes.

Table 4.2 ASA risk score

ASA classification	Definition
ASA I	A normal healthy patient
ASA II	A patient with mild systemic disease
ASA III	A patient with severe systemic disease
ASA IV	A patient with severe systemic disease that is a constant threat to life
ASA V	A moribund patient who is not expected to survive without the operation
ASA VI	A declared brain-dead patient whose organs are being removed for donor purposes

ASA denotes the American Society of Anesthesiologists

In order to achieve a more objective assessment with better prognostic information, several risk scores have been developed. The most used score is the ASA (American Society of Anesthesiologists, Table 4.2) grading showing a statistically significant association between mortality and morbidity [2]. ASA takes both the patient's current state and comorbid conditions into account. The patient is graded from 1 to 5, where 1 is previously healthy and where 5 is a patient with critically ill/life-threatening condition [26, 27].

The Acute Physiological and Chronic Health Evaluation (APACHE II) score is mostly used in the ICU, but can also be used in the emergency patient to assess the physiological consequence of the acute illness while taking into account the patient's previous status and age [9, 16, 25, 28]. However, most scores work best on a group level for comparison and are less good in individual outcome prediction.

The Physiological and Operative Severity Score (POSSUM) uses 12 physiological variables and 6 operative variables to predict mortality and morbidity within 30 days after performed surgery [25, 29]. It has also been used to compare individual performance between surgeons and surgical institutions. Because POSSUM consistently over-predicted mortality, it was further developed to different specialty-specific models, two of them being CR-POSSUM, colorectal POSSUM, and P-POSSUM, Portsmouth POSSUM. They predict mortality more accurately compared to POSSUM; however, they do not predict morbidity [25]. It should also be noted that both POSSUM and P-POSSUM are found to underestimate morbidity and mortality in patients who were admitted acutely and in patients of older age and therefore should be used with caution in these settings [9, 25, 28]. These scores are best for comparison of outcomes and risk between groups rather than decision-making for the individual patient.

Taken together, assessing the emergency patient with colorectal cancer includes stage, type of acute presentation, comorbidities, medications, patient's cognitive state, and preferences for further treatment. For the patient to make a well-informed decision, the risks of surgery in addition to the underlying disease must be declared. The diagnosis of disseminated incurable disease or severe comorbidity should initiate a sound reflection on possible treatments and involvement of the palliative team [30].

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