

# Surgery for colorectal cancer

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## Abstract

Colorectal cancer surgery represents a major component of the colorectal service workload. A solid understanding of key anatomical and oncological principles is essential for safe practice. In this article we discuss these fundamental aspects of colorectal cancer surgery. The first part of the article will deal with preoperative staging, surgical planning and principles of oncological surgery. The second part will focus on some of the commonest operations. We will describe key intra-operative principles involved in performing a right hemicolectomy, left hemicolectomy, anterior resection and abdomino-perineal resection. Laparoscopic colorectal cancer surgery is increasingly widespread and therefore our perspective will assume this approach by default. In the final section, we discuss the role of radiotherapy in rectal cancers, transanal surgery, resection of colorectal liver metastases and the rationale behind follow-up.

**Keywords** Colorectal cancer; laparoscopic; surgical resection

## Introduction

Colorectal cancer is the fourth most common cancer in the UK. In 2013, there were approximately 41,000 new cases in the UK; 23,000 (56%) cases in men and 18,000 (44%) in women, giving a male:female ratio of 13:10.<sup>1</sup> Geographically, the incidence of colorectal cancer is highest in Western Europe and North America. Multiple risk factors are associated with its development; these include smoking, alcohol, diet (excessive red meat and processed food consumption), obesity and decreased physical activity. Inflammatory bowel disease is also associated with increased risk in proportion to the extent of bowel involvement and duration of disease.

The majority of colorectal cancers are sporadic whereas 5–10% are inherited syndromes, for example hereditary non-polyposis colon cancer (HNPCC) and familial adenomatous polyposis (FAP). There may be some overlap of genetic abnormalities involving sporadic and inherited forms. The risk of colorectal cancer for an individual with a first-degree relative with the disease is three times greater than one who has no family history. Vogelstein proposed a multi-step model identifying key mutations.<sup>2</sup> Although colorectal carcinogenesis involves a complex interplay between environmental and genetic factors, key mutations appear

to involve APC, KRAS and p53 genes. The most common histopathology for colorectal cancer is adenocarcinoma. The development of colorectal adenocarcinoma is postulated to follow the adenoma–carcinoma sequence. In this model, there may be a natural progression from benign polyps into invasive cancerous lesions. The national bowel cancer screening programme was set up in 2006 based on this model, which is widely accepted.

About 20% of cases present as emergencies and these are associated with a poorer outcome.<sup>3</sup> Early presentation is key to improving outcomes for colorectal cancer and the management of pre-invasive lesions. Approximately 30% of cases occur in the rectum and 20% in the sigmoid colon. About 20% develop in the right colon and 10% are found in the transverse or left colon. Approximately 80% of newly diagnosed cases will require surgery. Surgery remains the primary treatment for the majority of cases of colorectal cancer both as treatment with curative intent and as a palliative therapy.

## Staging and imaging of colorectal cancer

The single most important factor that determines the outcome is the stage of cancer at presentation. The international standard used for staging is referred to as the TNM classification. Prognosis is intimately linked to the invasiveness of the *tumour* (*T*), extent of regional lymph *node* (*N*) involvement and the presence of distant extra-intestinal *metastases* (*M*). Clinical staging is with colonoscopy, computed tomography (CT) scan of the chest abdomen and pelvis and magnetic resonance imaging (MRI) scan of the pelvis for rectal tumours. Indeterminate lesions in the liver may require further assessment with MRI or ultrasound. Positron emission tomography (PET) scan may also be helpful in determining sites of disseminated disease. Diagnosis is usually by colonoscopic examination. Even if diagnosis has been by alternative methods such as CT, colonoscopy is mandatory in order to acquire biopsies and exclude synchronous lesions. The reported incidence of synchronous colorectal lesions ranges between 2% and 9%.<sup>4</sup> The incidence is variable as it depends on the degree of diligence with which the rest of the large bowel is assessed after detecting one lesion.

CT may be used as a tool not only for diagnosis but also for assessment of local complications such as fistula and abscess formation. CT will also identify common sites of metastatic spread such as liver or lungs. MRI may be particularly useful in assessment of rectal tumours in order to gain an appreciation of relationship with the mesorectal fascia and mesorectal nodal status (Figure 1). Involvement of this fascial boundary known as the circumferential resection margin (CRM) may be an indication for neoadjuvant therapy in order to downgrade tumour size and reduce the likelihood of a positive CRM. MRI is also more sensitive at detecting colorectal metastases to the liver. PET–CT is a combined modality not usually used for staging, however it does play an important role in identification of possible recurrent disease. A pitfall is that areas of infection or inflammation may ‘light up’ on PET scans due to uptake of the radiolabelled isotope, fluorodeoxyglucose (FDG).

## Preoperative considerations

As with all cancer surgery today, a careful multidisciplinary team (MDT) approach should be employed to ensure the best possible decision and outcome for each patient. The first step is to establish whether disease is localized or disseminated. The

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**Figure 1** Axial T2 weighted image of the pelvis – arrows mark the mesorectal fascia. [With permission from Griffin and Grant, Grainger & Allison's Diagnostic Radiology Essentials, Pages 294-313, Elsevier, 2013].

operative strategy should be based on fundamental principles of oncological surgery, discussed in the next section. Laparoscopic colorectal surgery is gradually becoming the standard of care around the UK rather than something carried out only in 'specialist' centres. The introduction of the LAPCO training programme<sup>5</sup> has resulted in an increase in consultant surgeons performing laparoscopic colorectal surgery. A key aspect in generating successful outcomes from colorectal cancer surgery is to work closely in concert with anaesthetists, cardiologists and respiratory physicians, amongst others, to stratify risk and address modifiable factors e.g. ischaemic heart disease, asthma, diabetes. Cardiopulmonary exercise testing (CPET) (Figure 2) may be used to stratify high-risk patients.

A frequently debated topic is whether to give routine bowel preparation or not. Bowel preparation may cause significant dehydration and electrolyte derangement<sup>6</sup> and is unpleasant for



**Figure 2** Photograph of a patient doing a cardiopulmonary exercise test. [With permission from Young et al., A Systematic Review of the Role of Cardiopulmonary Exercise Testing in Vascular Surgery, European Journal of Vascular & Endovascular Surgery, Volume 44, Issue 1, Pages 64-71, Elsevier, 2012].

the patient. It can also precipitate obstruction or create dilated fluid-filled bowel proximal to near obstructing lesions. At the Minimal Access Therapy Training Unit (MATTU) in Guildford, we have a policy of no bowel preparation for right-sided lesions, a preoperative enema for left-sided lesions and restrict full bowel preparation to patients having low rectal resections with anastomosis and defunctioning ileostomy. This represents just one aspect of ERAS (Enhanced Recovery after Surgery).<sup>7</sup> Other key components that require attention are preoperative carbohydrate loading, opioid-sparing analgesia, perioperative fluid regimes, early mobilization and nutrition. The standard of care in our unit for patients undergoing laparoscopic colorectal surgery is to receive a spinal or patient-controlled analgesia for postoperative analgesia and oesophageal Doppler monitoring (ODM) for goal-directed fluid therapy. The Guildford experience has shown that it is possible to discharge selected patients as early as 23 hours after laparoscopic colorectal surgery by incorporating such techniques within an ERAS pathway.<sup>8</sup>

### Oncological principles in colorectal cancer surgery

The goal of surgery is to resect the primary tumour en bloc with clear resection margins and include all draining locoregional lymphatics that may contain micrometastases. In order to understand the extent of bowel resection and lymphadenectomy one must have a clear understanding of the anatomical principles behind lymphatic spread.

Longitudinal intramural lymphatic spread in the colon rarely exceeds 2 cm, hence the rationale for 5 cm resection margins proximally and distally. For rectal cancers, sphincter-saving techniques allow most patients to avoid abdomino-perineal resection and a permanent colostomy; a 1 cm distal clearance is considered the minimum for an adequate rectal resection. Circumferential lymphatic spread proceeds centrally, usually in a step-wise fashion from epicolic and paracolic nodes eventually to the 'apical node', associated with a major vascular pedicle. In rectal cancers, Heald et al. advocated total mesorectal excision (TME).<sup>9</sup> TME is now the standard of treatment and has led to decreased recurrence rates.

Since the lymphatics run alongside arteries, the extent of segmental resection is determined by the vascular territories involved. The evidence increasingly confirms that laparoscopic resections are safe, oncologically equivalent to open surgery and have better short-term outcomes.<sup>10</sup> The choice of approach is perhaps more dependent on the individual department, surgeon expertise and training than anything else. The robotic approach is discussed elsewhere in this issue. Discussion of complications is beyond the scope of this article.

### Surgery for colon cancer

#### Laparoscopic right hemicolectomy

##### Surgical anatomy

The use of a laparoscopic approach does not imply deviation from fundamental oncologic principles stated above. To reiterate, this includes proximal and distal resection margins, proximal ligation of the main vascular pedicle(s) along with attached mesentery and en bloc resection of locally advanced colorectal tumours. Proximal or 'high' ligation at the origin of the feeder vessels is important to ensure the maximum number of lymph nodes within a complete mesenteric specimen ('total mesocolic

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