

# Causes and management of bleeding during laparoscopic colorectal cancer surgery

Xu Ming, Wu Weiqiang, Yang Zengqiang, Gao Feng\*

Department of Colorectal and Anal Surgery, Lanzhou General Hospital, Lanzhou, Gansu Province, China

**Abstract:** In this paper, the causes of bleeding during laparoscopic colorectal surgery and the measures to solve it are discussed. 386 cases of laparoscopic colorectal cancer surgery in our hospital from January 2015 to December 2015 were selected. There were 17 cases of bleeding during surgery, which accounted for 4.4% of the total amount. In 386 cases, 2 cases were converted to laparotomy, and 15 cases were surgery via laparoscopy. In the surgical process, improper surgery, lack of good laparoscopic anatomical structure of the cognitive level, and congenital anatomic variation may have caused accidental bleeding during surgery. Corresponding measures should be taken to stop accidental bleeding.

**Keywords:** Laparoscope; Colorectal cancer surgery; Causes of bleeding; Processing strategy

## Introduction

The clinical application of laparoscopic surgery cases are increasing and laparoscopic colorectal surgery has also been widely recognized. Accidental bleeding is one of the most common complications in colorectal cancer surgery. It is also the most important cause of conversion to open surgery, and if the treatment is not timely, the consequences are very serious. Therefore, it is a basic requirement for every clinician to effectively master the method of hemostasis in laparoscopic colorectal cancer surgery.

## Data

In this study, we selected 17 cases of accidental bleeding during laparoscopic colorectal cancer surgery, including 11 males and 6 females (aged 52–81 years old, with an average age of 63 years old). In 3 cases, the main symptoms were hematochezia, defecate change in 7 cases, 4 cases of weight loss, 1 case of abdominal distension, and no obvious symptoms in 2 cases. There were 5 cases with positive signs, such as abdominal mass. 12 cases had no positive signs. In 1 case, the tumor was located in the cecum, ascending colon in 3 cases, descending colon in 3 cases, sigmoid colon in 3 cases, and rectum in 7 cases. There was 1 case of clinical stage I, 9 cases of stage II, and 7 cases of stage III. Colonoscopy was performed on 1 case of adenocarcinoma.

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## Methods

All patients underwent standard laparoscopic radical resection of colorectal cancer. Any accidental intraoperative bleeding of 100 mL was recorded, the causes of bleeding analyzed, and the countermeasures summarized.

## Statistical methods

The results were analyzed using SPSS 16.0 statistical software, measurement data using mean  $\pm$  standard deviation ( $x \pm s$ ); count data was expressed as a percentage and were compared using  $\chi^2$  test. Intraoperative unexpected massive bleeding was the dependent variable and patients with clinical data and possible hemorrhage factors as independent variables. Using multivariate logistic regression analysis,  $P < 0.05$  is statistically significant.

## Results

2 cases of laparoscopic surgery was converted to open surgery. The first was a case of rectal cancer in the internal perineal vein injury bleeding (about 350 mL), the bleeding became more turbulent and was converted to open surgery to stop the bleeding. The second was a case of ascending colon cancer right colonic artery hemorrhage laparotomy hemostasis. The remaining 15 cases of intraoperative bleeding were under laparoscopic hemostasis. All patients recovered well after surgery, and had no other serious complications. Surgery time was 2.5–4.5 h, with an average of 3.2 h. The total amount of bleeding during operation was 150–400 mL, with an average of 260 mL. Postoperative recovery time was 2–7 days, with an average of 3.6 days. Postoperative hospital stay was 6–12 days, with an average of 8.2 days. There was 1 case of postoperative pathological Duck A stage, 9 cases of Duck B stage, and 7 cases of Duck C stage. (Table 1) Lists the cause of bleeding and the method of hemostasis.

Table 1. Causes of bleeding and the methods of hemostasis

Cause and location of bleeding	The number of cases	Hemostasis method
Treatment failure of large vessels	-	-
Right colic artery	1	Open hemostasis
Right branch of middle colic artery	2	Gauze packing with gauze + titanium clip Gauze packing and energy cutter head
Inferior mesenteric artery	2	Gauze packing with gauze + titanium clip
Left colon blood vessel	3	Titanium clip Gauze packing with gauze + titanium clip
Other branches of the sigmoid or inferior mesenteric artery	4	Gauze packing with gauze + titanium clip Gauze packing and energy cutter head Energy cutter head Titanium clip
Surgical injury	-	-
Right colic artery	1	Gauze packing + energy knife head + titanium clip
Left internal jugular vein	3	Open hemostasis Gauze packing under microscope Gauze packing with gauze + titanium clip
Anterior sacral vein	1	Gauze packing under microscope

## Discussion

Due to the characteristics of laparoscopic surgery, it is prone to bleeding. According to published reports, the average per case of accidental bleeding from laparoscopic colorectal cancer surgery is 6.6 times. As the laparoscopic vision is

very small, if the hemorrhage amount is large, vision will be quickly occupied; if it is under the pneumoperitoneum, negative pressure suction can quickly reduce the pneumoperitoneum space or lead to the space disappearing completely, and any operation at this time will be difficult. In addition, general laparoscopic monitors are two-dimensional, lacking depth. In the process of hemostasis, because it is not manually directed, the surgery would eventually lead to the conversion to laparotomy.

## **Causes of laparoscopic colorectal cancer surgery**

### **Bleeding caused by improper operation**

In the process of operation, due to bleeding caused by improper operation, accidents could occur from time to time. In the present study, in a case of ascending colon cancer laparoscopic colon resection, the left intestinal forceps used to pull the mesenteric unexpectedly pulled the right colic artery nylon clip off, leading to a massive hemorrhage and was later converted to open surgery. In 3 cases of laparoscopic rectal cancer radical surgery, the left pudendal meridians bleeding was due to the middle rectal tumor. An ultrasound knife isolated rectal ligaments, due to the lever, it caused the tumor body lift, resulting in venous injury. These cases of bleeding eventually lead to laparotomy. In a case of the inferior mesenteric artery hemorrhage, the vascular sheath mistakenly separated as the trunk clamping and the true trunk was cut off, leading to massive hemorrhaging. However, during surgery an accurate operation successfully produced hemostasis.

### **Thermal damage**

In laparoscopic surgery, doctors use a knife that is an ultrasonic scalpel and a high frequency electric knife; the two knives' lateral thermal damage range is 1 mm and 4 mm with a longitudinal thermal damage depth reaching up to 4 mm. Therefore, in order to prevent bleeding during surgical procedures, protection around the cutter head should be strengthened, the work knife head outward during the cutting procedure, and surgery around the blood vessels should be avoided. However, it is worth noting that in laparoscopic surgery for colorectal cancer, intraoperative bleeding often occurs due to thermal damage; especially if done by beginners. In addition, when cutting small blood vessels, if it is not fully clamped this would cause residual vascular wall injury bleeding. Therefore, in the process of surgery, it should be emphasized that the entire vessel is completely closed, and the use of breakwater technology be used.

### **Anatomical variations caused by congenital or tumor factors**

In this study, accidental bleeding occurred during a case of laparoscopic surgery for rectal cancer. The left colic artery is located relatively high; the inferior mesenteric arterial sheath is damaged during the separation process, eventually leading to accidental bleeding. After the accurate processing, successful hemostasis was achieved. In a case of ascending colon cancer laparoscopic right hemicolectomy resection, due to the roots of mesenteric vessels metastasis lymph nodes, the superior mesenteric forward vein moved to the top during surgery and it was almost removed. During the final separation and resection of the metastatic lymph nodes, the blood vessels should be clearly visible to avoid the occurrence of accidental of bleeding.

### **Strategies of bleeding during laparoscopic colorectal cancer surgery**

A qualified colorectal surgeon must be familiar with the various measures to deal with bleeding in laparoscopic surgery in the face of unexpected bleeding in surgery, effectively taking effective measures.

## Visibility

During surgery, visible bleeding position is the key to successful hemostasis under laparoscopy. Whenever bleeding occurs during surgery, the whole surgery team must cooperate with each other to maintain calm and not blindly rush to stop the bleeding to ensure effective pull, and the bleeding position revealed. The left hand holding the suction device is used to find the bleeding wound and the bleeding point.

## Suture

If the blood vessel wall is bleeding or if it is difficult to stop bleeding due to the location of the bleeding point, laparoscopic suture hemostasis is to be used. If the vascular wall bleeding can be blocked via clips or removed with an aspirator when bleeding points are exposed, sutures are not necessary. However, the requirements for laparoscopic suture operations are particularly high, not only requiring superb suturing and knotting techniques, but also requires patients having good psychological quality and good team cooperation ability; failing which would lead to expanding blood spots.

## Energy surgical technique

These include electric knives, electric coagulation sticks, ultrasonic knives, LigaSure, argon knives, and other equipment. Electric knives, electric coagulation rods, and argon knives are mainly used in small blood vessels hemorrhage, liver, spleen, and other substantive bleeding organs and large wounds. In the process of hemostasis, the wound is drained either by using gauze or a suction device. Ultrasonic knives and LigaSure can be used when blood vessels with a diameter of 5–7 mm are involved; their heat radiation ranges are small, and are easy to use. In fact, these two energy equipment are used when dealing with accidental bleeding of larger blood vessels. In our experience, it is safe to administer LigaSure treatment on 3 mm diameter arteries and a diameter of less than 2 mm would require the application of breakwater technology. The proximal end of the inferior mesenteric artery, the left main artery, and the proximal end of the main artery needs to be treated with exact vascular clamps; large blood vessel hemorrhage within the scope of resection can be treated with energy surgery. Good results can be obtained by applying electric coagulation in the active bleeding or small blood vessel bleeding.

## Bleeding from large blood vessels

During surgery, if arteries and other large vessels bleed, the bleeding is more ferocious, by using hemostatic gauze, laparoscopic vision will quickly narrow, the negative suction pressure sustained, the intraperitoneal space reduced, and surgery cannot continue. Surgery technique would then convert to laparotomy, under direct vision to stop the bleeding. If bleeding could not be controlled with gauze and other techniques failed to achieve complete hemostasis, the surgery would be converted to laparotomy.

In summary, in laparoscopic colorectal surgery, it is most important to prevent the occurrence of bleeding. Detailed vascular anatomy, accurate processing of vascular anatomical variation and gentle manipulation can effectively avoid the occurrence of accidental bleeding. Skillful laparoscopic operation and stable psychological quality is the key to resolving accidents.

## Conflict of interest

The author declares no potential conflict of interest with respect to the research, authorship, and/or publication of this article.

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