



Study on Optimized Patient Position and Nursing Coordination for 3D Laparoscopic Assisted Total Colectomy Based On Membrane Anatomy

Shuyan Xia¹, Yang Li¹, Tiyu Zhao¹ and Ying Wang^{2*}

¹Operating Room of Tongji Hospital affiliated to Tongji Medical College, Huazhong University of Science and Technology, China

²Nursing Department of Tongji Hospital affiliated to Tongji Medical College, Huazhong University of Science and Technology, China

***Corresponding author:** Dr. Ying Wang, Nursing Department of Tongji Hospital affiliated to Tongji Medical College, Huazhong University of Science and Technology, Wuhan, 430030, China, Tel: (86) 13647207882; Email: 752460170@qq.com

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Abstract

To compare and assess the intraoperative and postoperative impact of different patient care coordination on 3D laparoscopic assisted total colectomy based on membrane anatomy and open surgery. A total of 48 patients registered for total colectomy between January 1, 2016 and December 31, 2018, were enrolled to this study and assigned into two groups: 24 patients for the 3D laparoscopic assisted total colonic resection as test group and the other 24 for the open surgery as control group. Intraoperative bleeding volume, operation time, time of hospitalization, and postoperative complications were recorded for all the patients and compared between the two operation procedures.

Compared to the patients with open surgery procedure, patients of test group were detected with a slightly shorter operation time ($P < 0.05$). However, the surgery with 3D laparoscopy showed to be much more beneficial to the control group patients including significantly reduced intraoperative blood loss, significantly reduced postoperative complications, and significantly shorten the length of hospitalization ($P < 0.05$). 3D laparoscopic assisted total colectomy under the membrane anatomy shows several advantages as compared to open surgery. It facilitates a much clearer vision of surgery field, distinct view of anatomic structure and localized anatomic space, and relative surgery safety. Nurses in the operating room play an important role through close cooperation with the surgeon and improving the quality of intra-operative coordination from room layout, instrument set up and use to the position adjustment during surgery.

Keywords: Membrane anatomy; 3D laparoscopy; Total colectomy; Intra-operative coordination

Abbreviations: CME: Complete Mesocolic Excision

Introduction

With the wider application of laparoscopic surgery, laparoscopic surgery, especially the laparoscopic surgery of the gastrointestinal tract has been more developed in recent years [1]. Due to the complex and longtime operation procedure [2], and other related factor, the laparoscopic total colon resection was not commonly applied in China. In 2009, the German surgeon Hohenberger et al. [3] suggested that in the course of colon cancer radical surgery, it is important not only to carry out the high ligation to corresponding blood vessels (i.e, D3 lymph node dissection), but also to completely remove the corresponding mesocolon (complete mesocolic excision, CME) [4]. The current result shows that application of the CME has resulted in reduced the local recurrence rate of colon cancer. Large sections of mesenteric tissue after colonic surgery revealed that there existed a certain proportion of cancer cell metastasis within the envelope of the mesangial tumors. This metastasis is only present in a separate cavity and called the "fifth transfer (Metastasis V), which is different from the four metastatic modes known to gastrointestinal tumors, namely direct invasion, peritoneal dissemination, hematogenous metastasis, and lymphatic spread. In 2011, Mr. Jianping Gong, the surgeon of our gastrointestinal surgery department for the first time proposed the concept of the "membrane anatomy" and "fifth transfer" to the world, and started to implement the 3D laparoscopy-assisted total colon resection new surgical approach under membrane anatomy. This manuscript describes the application of this technology in our hospital with the emphasis on the importance of surgical position of patients and care coordination from operating nurses for achieving surgery success.

Methods

Subjects

A total of forty-eight patients underwent total colonic resection during January 1, 2016 to December 31, 2018 were enrolled in this study. These subjects were divided into two groups in terms of same location and extent of lesion: test group containing 24 patients (male 13, female 11) underwent 3D-laparoscopic total colonic resection, and the other 24 subjects (male 14, female 10) were arranged for open surgery as control group. There was no statistical difference between the two groups in terms of gender, age, and body mass index (Table 1).

Criteria for subject (inclusion and exclusion)

Inclusion criteria: Patients with colon cancer undergoing sigmoid colon, left colon, transverse colon, right hemicolectomy and lymph node dissection.

Exclusion criteria: Following patients are excluded for this study, including colorectal cancer patients with other organ metastasis, those with preoperative use of anticoagulants, patients with severe liver dysfunction, those with preoperative coagulation dysfunction.

Surgical methods

There are 4 major steps involved in the application of 3D laparoscopy- assisted total colonic resection surgery under the membrane anatomy: 1). Laparoscopic stage: the stage for the establishment of pneumoperitoneum; misplacement of trocar (six holes method) as shown in Figure 1; free sigmoid colon, left colon, transverse colon, right colon, cecum and other anatomical sites; ligation of the mesenteric artery and vein (ileocolon artery and vein, right colon artery and vein, the middle colon artery and vein, rectal artery and vein, sigmoid artery and vein, left colon artery and vein), and dissect lymph nodes. 2). Laparotomy stage: remove and identify specimens for digestive tract reconstruction; and use stapler for Ileum and rectal anastomosis. 3). Laparoscopy inspection stage: flushing, and exploration of the abdominal cavity, checking for any bleeding, placing hemostatic material if necessary. 4). Checking and accounting used instrument, place drainage tube, and close the abdominal cavity (Figure 1).

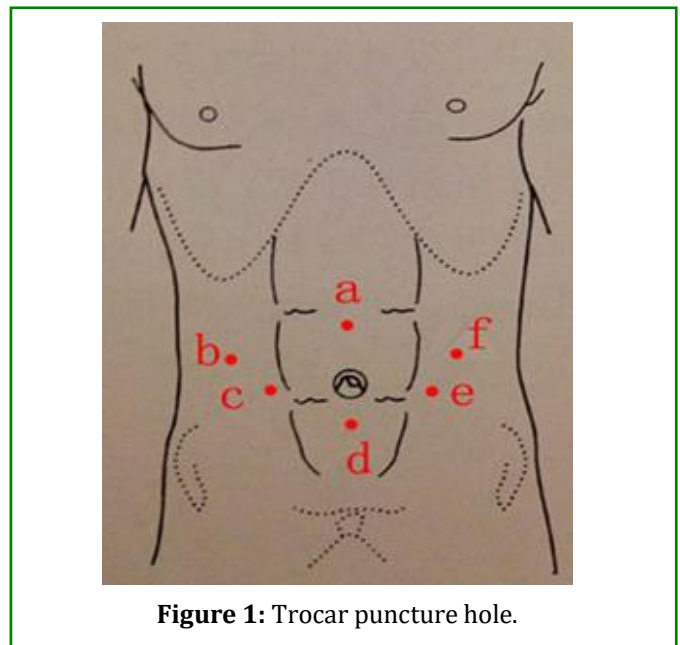


Figure 1: Trocar puncture hole.

Nursing coordination

Coordination from circulating nurses: Responsive coordination of circulating nurse includes: 1) Check the patient's name, sex, unit, operation type, if allergy to any drug, blood type, result of cross-matching blood test, and check the preoperative medication and confirmation with the anesthesiologist; 2) Once completion of the confirmation, rapidly establish Intravenous access, assist the anesthetist in anesthesia; monitor blood oxygen saturation, ECG, blood pressure, pulse, and respiration. Carefully check the high frequency electrotome, suction apparatus, make sure laparoscopic imaging system and laparoscopic instruments to be prepared; 3) Following the disinfection and draping, complete all connection of the monitoring screen, light source, pneumoperitoneum machine, suction apparatus, and make sure everything works; prepared 70°C saline in Insulation cup to warm the lens and to ensure clear vision of surgical field [5]; 4) Check the operating table leg plate to ensure its firmness and flexibility.

Carefully check the leg panels for sound installation both preoperatively and postoperatively. According to the surgical requirements, stick the negative plate close to the patient muscle; be sure the full exposure of the surgical site; in order to prevent skin from electrical burns, patient limbs need to be wrapped with cloth sheet; also fix bilateral upper limb to both sides of the body to avoid the contact between limb skin and metal parts of operation table; Add soft pad to the pressure area of the limbs and use shoulder pads to hold up the shoulders to prevent the pressure. To prevent body sliding down, fix both lower

legs to lithotomy bracket; try to minimize body exposure as possible to keep warm, keep the patient limbs in functional position. 5) Check and count all instrumental items and keep good records; check to make sure the equipment to be intact and correctly connected; ensure gas (CO₂) is sufficient, and also check the lights and have 3D glasses ready. The surgeon's 3D glasses should be firmly fixed and so to prevent any glasses slip in the course of surgery operation.

Coordination from instrument nurses: To achieve the optimal operation, several preparations are essential for instrument nurses including: 1) Preoperative preparation: instrumental nurses need to wash hands 20min ahead of surgery schedule, so to ensure to have the time to check the inventory of all instruments to be used for laparoscopic and open surgeries (Figure 2). 2) Check to make sure the pneumatic needle to be unobstructed with good elasticity; work together with the circulating nurse to make collection of all the pipes, wires and instruments, and all these connections need to be properly fixed. 3) Intraoperative cooperation: be familiar with the surgical process, closely cooperate with the surgeon, such as to pass different kinds of surgical instruments in time according to the surgeon's need, and actively deliver the needed instruments to surgeon's hands using the most appropriate method of operation. All the instruments need to be gently handled (picking up and placing down) in the operation, and take back immediately upon their use, place them on the instrument trolley neatly and orderly [6], and so to avoid equipment damage due to collision.



2A



2B

Figure 2: Apparatus placement for different surgeries. The setting up for 3D Laparoscopic surgery (2A) and the setting up for open surgery (2B).

	3D laparoscopic surgery	Open surgery	P value
Subjects (n)	24	24	P>0.05
Male No.	13	14	
Female No.	11	10	
Age (year)	36.93 ± 15.85	38.58 ± 15.60	P>0.05
BMI** (kg/m ²)	23.10 ± 2.70	22.60 ± 2.30	P>0.05
Operation time (h)	4.36 ± 1.06	6.08 ± 1.14	P<0.05
Bleeding amount (ml)	155.83 ± 107.01	321.43 ± 214.58	P<0.05
Hospitalization time (days)	20.46 ± 6.76	26.80 ± 7.60	P<0.05
Postoperative complications	2/24	8/24	P<0.05

Table 1: Comparison between 3D laparoscopic surgery and open surgery*.

*Age, body mass index, operation time, blood loss, and length are all expressed mean ± standard deviation.

** BMI = body mass index

Results

Compared to the patients with open surgery procedure, patients of test group were detected with a slightly shorter operation time ($P < 0.05$). However, the surgery with 3D laparoscopy showed to be much more beneficial to the control group patients including significantly reduced intraoperative blood loss, significantly reduced postoperative complications, and significantly shorten the length of hospitalization ($P < 0.05$).

Discussion

Membrane anatomy and the proposed concept about the fifth transferThe gold standard for radical surgery of gastrointestinal tumors is to remove the primary lesion and its related tissues [7]. With the introduction of the concept of complete mesorectal excision (CME), people began to recognize the importance of surgical anatomical level, and then developed it into the "membrane anatomy". Membrane anatomy is a surgery operation between the gross anatomy and microanatomy. And it is basing along the pattern of membrane anatomy to search for the "holy plane", achieving a more complete meaning of minimal invasive surgery [8]. With the proposal of "Fifth Transfer" concept (i.e, cancer metastasis between mesangial fat), the understanding for mesorectal excision and membrane become more urgent. It is very difficult to find a tiny gap at the edge of the mesorectum by "naked eye surgery" (gross surgery). However, with the introduction of 3D laparoscope into the clinic, the excision of CME can be completed through using ultrasound knife with cavity effect [9]. Damaged blood vessels, nerves and organs were often occurred and covered by the membrane under mesangial bed surface in the past surgery, which can now be effectively avoided through the application of the membrane separation. It is precisely because that membrane anatomy has provided essentially anatomical basis for the surgeon for "Membrane

separation", which has changed the regularly surgical bleeding into today's "micro-bleeding".

Superiority of the 3D laparoscopy

3D laparoscopic surgery system is gradually applied to clinical to date. The more clearness of the interstitial space is much clearer under the 3D laparoscopy, especially for deep tissue, the organizational structure is readily identified at a glance, which makes the operation to be much safer and less time-consuming. Compared to traditional surgery for total colon resection, Laparoscopy-based total colectomy is a new surgical technique with several advantages, including less intraoperative bleeding, shortened hospital stay, and less operation related complications. However, it may take some more time compared to other gastrointestinal surgeries due to many separation sites, frequent changes in intraoperative position, and the change of a variety of instruments and surgical staff stations. Most importantly, the operation under 3D vision not only retains the fine and minimally invasive features of ordinary laparoscopic surgery, but also has the advantages of high-definition stereoscopic view, which largely improves the accuracy of operation [10,11].

3D laparoscopy can restore the true three-dimensional stereoscopic view of tissue structure and accurate spatial positioning, and provide the surgeon and the viewers with anatomical depth and three-dimensional level of the anatomy, thus improving the accuracy of complex surgery such as total colon resection, lowered operational risk, and reduced occurrence of intraoperative bleeding and surgical complications [12].

Surgical position and layout adjustment

Laparoscopic surgery is different from the traditional laparotomy, and it is based on the use of pneumoperitoneum and viscera of gravity to expose

surgical field and vision. Thus, this surgery requires to place the body at such a position not only for fully exposed surgical field, but also for conducive operation for the surgeon; and such a body position will not affect the cooperation between instrument nurse and the surgeon, and also not affect the circulating nurse to observe both the vital signs of the patient and the operation of the anesthetist. General requirements for the placement of surgical position are as following [13]:

- Easy for surgical operation. Because of the limited small space with laparoscopic operation and required separation to be performed at different directions and angles by the surgeon holding instrument, surgical placement should not impede the operation of the device from different angles, thus avoiding any inter-device conflict resulted from improper postoperative position.
- Enhanced fully exposed surgical field of view. Laparoscopic surgery is different from laparotomy in that the latter can directly view the surgical field through hand and dressing while laparoscopic surgery is largely dependent on proper placement of the patient position in order to obtain a desired exposure of the surgical organ. Also the surgical position of the patient should be placed in such a way to allow surgeon to conduct operation and also to observe the patient from different directions. Therefore, surgical position of the

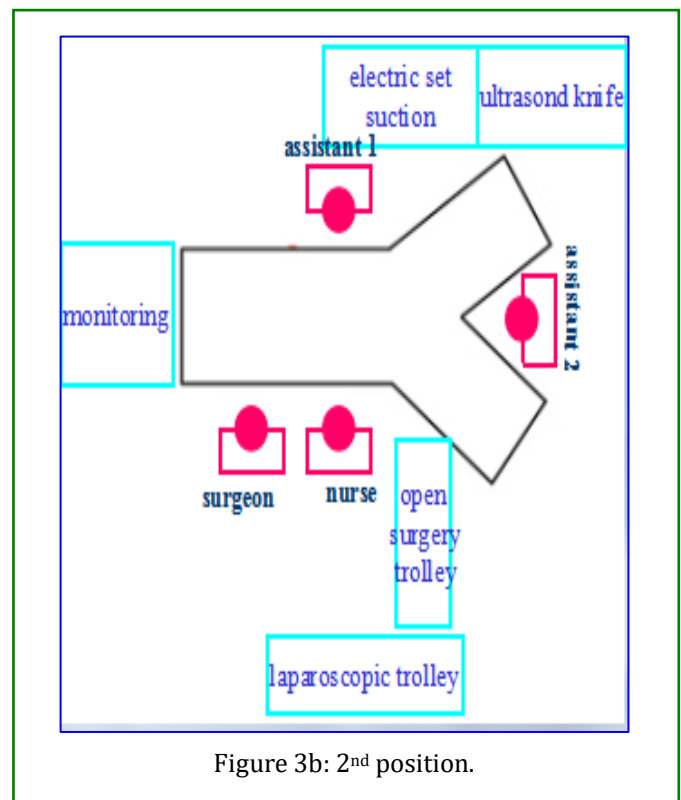
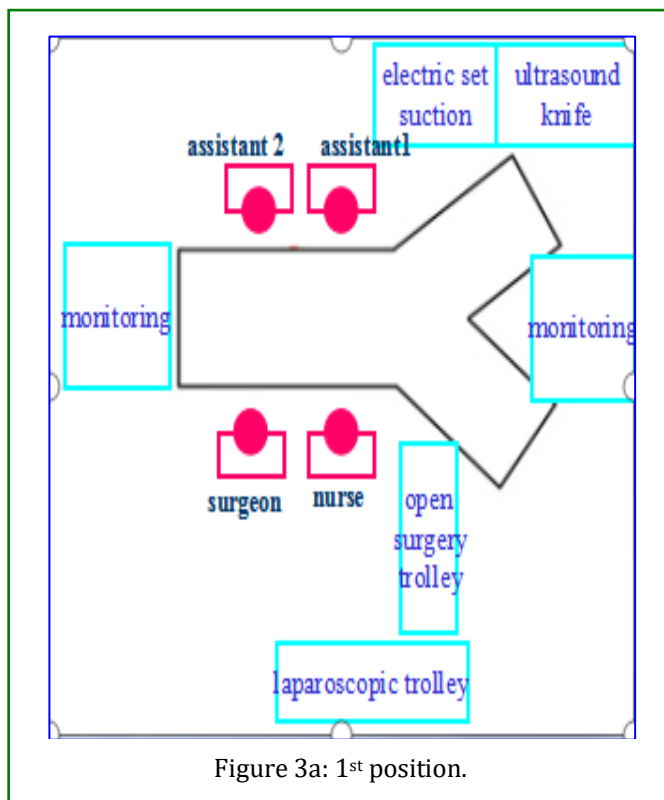
patient's should be subjected to appropriate adjustment during surgery process basing on the need of the surgeon.

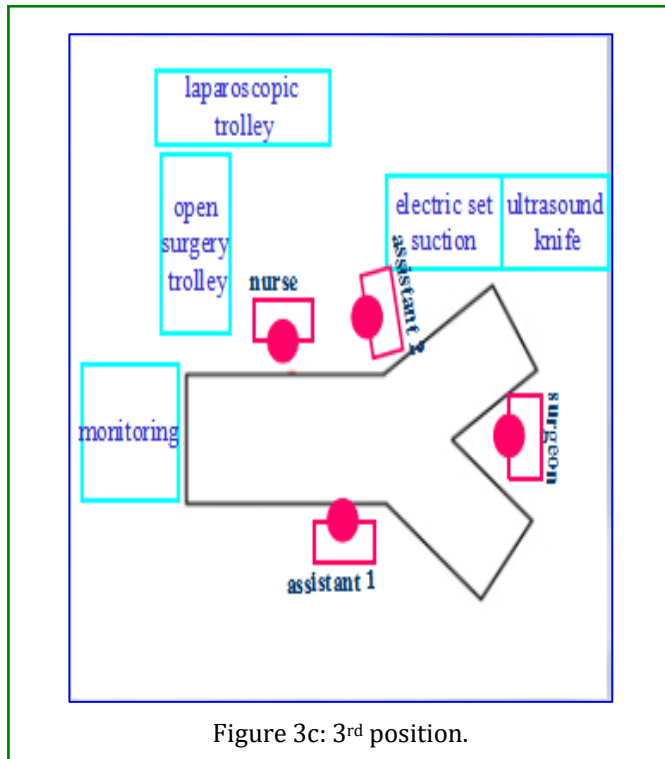
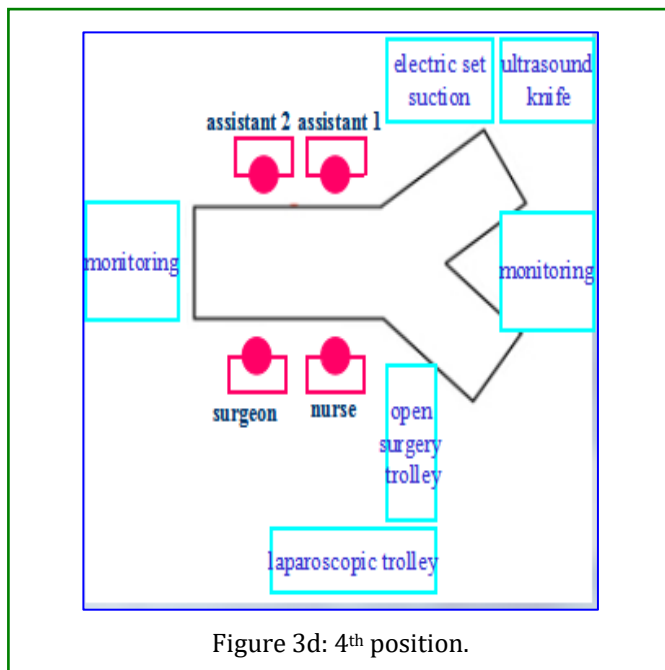
- Laparoscopic operation is a safe and comfortable procedure and it does not cause intraoperative related complications, does not affect the observation of vital signs and the anesthetic effect. And it is surgery to be conducted in an integrated operating room with overhanging multiple displays, which can meet the requirements of multiple position adjustment and personnel station change during surgery according to the operation. The placement of displays is also changed from between the legs to the left side of the body, and then toward the head direction. It is important to move the displays at different locations to the appropriate orientation according to surgical separation sites during the surgery, and this will lead to reduced flow of people and reduced movement of all the surgery instruments and device, avoid the frequent change of power jack. Therefore, reducing the risk of contamination of sterile areas and equipment damage and loss [14,15]. Station location of surgical nurses should also be changed and adjust but not be generalized according to different parts of the operation. In short, the nurse needs to change the station in order to better coordinate with the surgeon and to facilitate the surgery operation (Table 2).

Position adjustment	Patrol nurse coordination	Patient	Instrumental nurse coordination	Surgery room layout
Position 1	Patients with low lithotomy position - in which his hip moved to the surgical bed legs plate half-moon opening, legs placed in the bracket frame, the force point in the gastrocnemius muscle. Legs open 60 °, the left leg is about 10cm higher than the right leg. Right leg and the operating table angle maintains 15 ° or less	Treatment of sigmoid colon: the surgeon stands on the right side near patient's waist, assistant stands on the left side of the patient's body.	The instrument nurse stands on the right leg of the patient body, and be sure to timely exhaust gas and keep a clear vision while the surgeon frequently uses ultrasound knife; and pay more attention to the pneumoperitoneum machine and to maintain abdominal pressure during the course of Continuous gas exhaust.	Figure 3a
Position 2	Upon puncture positioning all the 6 Trocar holes, adjust the patient body to the position at head low and foot high by operating the surgical bed at the level of 25 ° or so. Then returned to 20 ° position once the	Treatment of left colon and transverse colon Splenic curvature: When dealing with inferior mesenteric artery and vein and surrounding lymph nodes, be sure to expose and protect the	When separating the duodenum, be sure to transfer gauze to mark urethra to prevent any error and damage, holding the cotton to separate the space of membrane. Pay more attention to the use of separation forceps, cooling ultrasonic knife.	Figure 3b

	surgeon moved the small intestine to designed specific area. Then moved the operation bed right when free left colon, adjusting the patient position to the right low and left high to 15 ~ 20 °.	ureter. Ultrasound knife cut the peritoneum, along the mesenteric root cut down the mesocolon.		
Position 3	Adjust the operation table left-leaning when free right colon, also adjust patient's position to the left low right high at 15-20°	Treatment of transverse colon liver curvature and right half colon, and the surgeon transposed between the patient's legs. ◦	The instrument nurse translates the two instrument tables from the right leg area to head area of the patient on the left . It is ok to remove the gauze at this time.	Figure 3c
Position 4	Make a small abdominal incision to remove the colon after separation end, and return the operation table to regular level and remain this position till the end of the surgery procedure.	Reconstruct digestive tract through the small abdominal incision once laparoscopic separation ends. The surgeon transposes to the patient's right side.	The instrument nurse transposes to the right side of the patient's body.	Figure 3d

Table 2: Surgical position and operation room layout adjustment.



Figure 3c: 3rd position.Figure 3d: 4th position.

Several important notes for surgery nurses

Because of the important role to success in laparoscopic operation, surgical nurses need to have the proficiency in good control of laparoscopic instruments and good cooperation with the surgeon closely during the entire of

operation process [16]. In particular, the nurses need to be well prepared in following areas: 1) In order to maintain intraoperative lens clear, saline should be maintained at 70° for ready use to wipe the lens in case of lens get fogged during operation. 2) At the time when ultrasound knife is frequently used, the instrument nurses need to open the Trocar vent for air deflation to improve the operative sight and ensure the surgical field to be clear. 3) Any scab attached to the ultrasonic knife needs to be scrubbed timely to protect the coagulation effect. 4) When the vascularization operation is performed, the instrument nurse needs to assist in cooling ultrasonic knife head to avoid potential damage to the blood vessels from the misuse of surgical device. 5) The instrument nurses need to carefully check if the anatomical ring is completely formed at both end and then report this to the surgeon as soon as circular stapler firing anastomosis is removed. 6) In order to prevent the occurrence of needle and thread separation when conducting continuous suture of pelvic peritoneal within body cavity, nurses should not choose to use the 3-0 absorbable line designed for easy tail separation.

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