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How I do it

Suctionable Gauze Ball Operated by the Console Surgeon Overcomes Wet Scenes during Robotic Rectal Surgery

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Abstract

Although robotic rectal resections are now widely performed, there are few robotic suction tools that can be easily used by console surgeons. It can therefore be difficult to maintain a clear visual field in the pelvis when there is effusion and bleeding from either a highly advanced cancer or from preoperative cancer treatment. In this report, we introduce our unique surgical technique that uses a soft catheter with a small gauze ball attached, inserted through the assistant port. This simple and inexpensive "instrument" can be used by the console surgeon as a retractor as well as a reliable suction device to secure their view of the operative field in the pelvis. This technique can be used in a narrow surgical field and does not rely on an assistant surgeon, making it potentially applicable to all types of surgery.

Keywords

robotic surgery, suction, retraction

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Introduction

Robotic surgery (RS), with its 3-dimensional imaging and multi-joint capabilities, is useful for resecting rectal cancer in the narrow pelvis, and acceptable results have been reported worldwide[1,2]. However, there is a lack of robotic suction tools that can be easily used by a console surgeon. Typically, an assistant surgeon provides suction using a straight laparoscopic tool[3], but interference with other robotic forceps and arms is common, making proper suction difficult[4]. The console surgeon is therefore often faced with a compromised surgical view, particularly when patients have advanced cancer or have completed preoperative chemoradiotherapy, which tend to lead to accumulation of exudate and blood in the pelvis. The use of existing robotic suction tools, including the EndoWrist One Suction Irrigator (Intuitive Surgical Inc., Sunnyvale, CA, USA); remotely operated suction and perfusion systems (ROSI)[5]; catheters with basket-like metal devices attached to the tip[6]; and modified assistant suction tubes[7] from the assistant port; has been reported, but none of these methods combine simplicity with cost effectiveness. There is room for improvement.

In this report, we present a simple, reliable, and unique suction system that effectively clears the surgical field with reliable suction and can also be used to provide traction. This method can be used by the console surgeon, without an assistant.

Methods

Preparation of the suction system

The tip of a 16F, 56-cm suction catheter (Nipro Corporation, Osaka, Japan) is cut off at the level of the side hole, and a small gauze ball with a radio-opaque contrast thread

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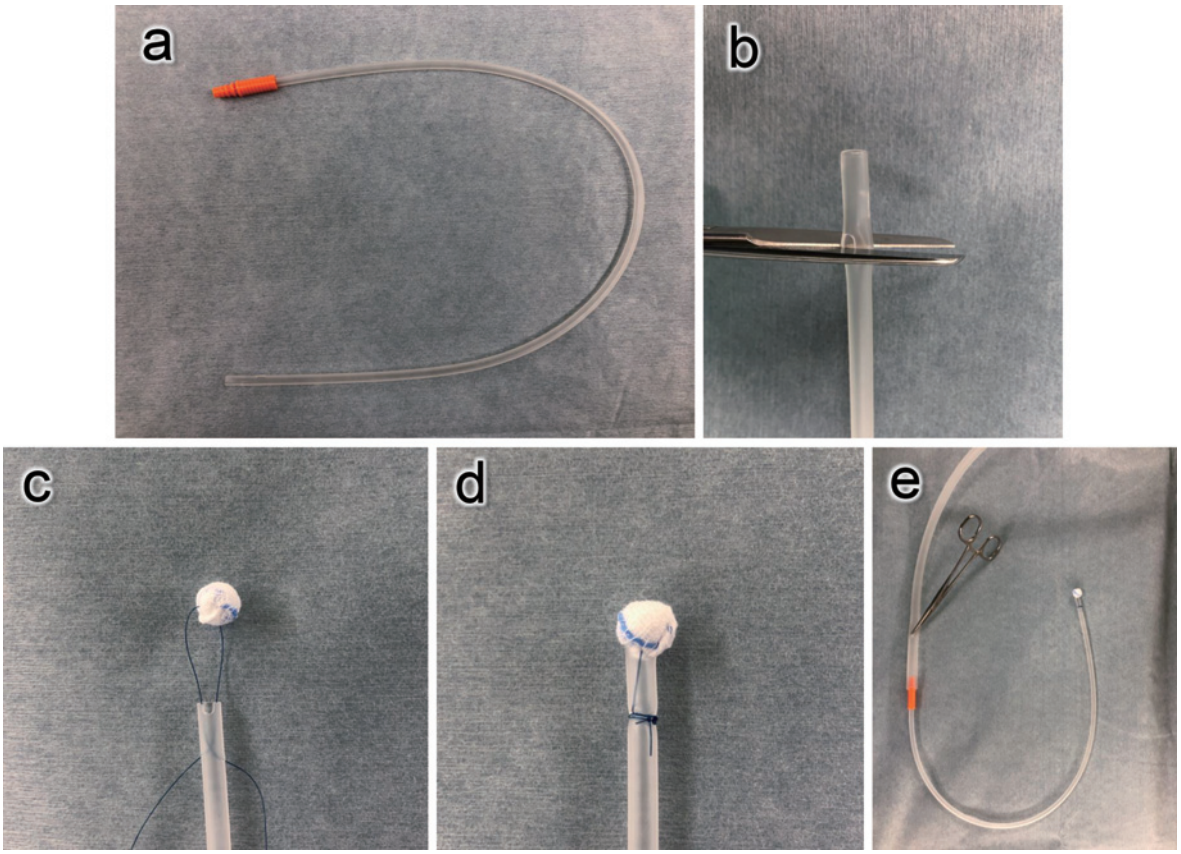

Figure 1. a-e. Process of gauze ball attaching. The tip of a suction catheter is cut off at the level of the side hole, and a small gauze ball is sewn onto the tip.

(Osaki Tupfer X, bell shape S; Osaki Medical Corporation, Aichi, Japan) is sewn onto the tip of the catheter using 3-0 nylon thread to adhere and stabilize the catheter tip (Figure 1).

How to use the suction device

After induction of general anesthesia, a small incision is made in the midline at the umbilicus, and a multichannel port device (EZ Access and Lap protector; Hakko Co., Ltd., Tokyo, Japan) with an 8-mm port and a 12-mm port was placed there. Intraperitoneal manipulation is performed after inserting a single port into the left upper abdomen, 2 ports into the right lower abdomen, and a 5-mm assistant's port in the right upper abdomen. At our institution, robotic rectal resections are performed using the da Vinci Xi surgical system (Intuitive Surgical Inc.). When suction is required in the pelvis, the catheter with the gauze ball is placed into the pelvis through the 12-mm port of the EZ Access and connected to a suction tube (Figure 2a). The pneumoperitoneum pressure can be maintained using the AIRSEAL System (ConMed, Utica, NY, USA), or alternatively, the assistant surgeon can use Kocher forceps to partially obstruct the suction tube and adjust the level of suction applied (Figure 2b).

For surgery in areas where exudate or blood has pooled, such as the bottom of pelvis, this gauze-tipped catheter can be inserted into the pelvis to allow suction without adsorbing surrounding tissue. It was also possible for the console surgeon to grasp and move this catheter for suctioning (Figure 3a-b). Furthermore, this gauze ball can also be used to press on the sidewall and expand the surgical field, allowing the surgeon to maintain a good field of vision in the narrow pelvic cavity (Figure 3c-e).

Discussion

In this report, we describe a novel suction system that utilizes a gauze ball; this instrument can be used by a console surgeon to overcome the lack of adequate suction systems for robotic surgery. With the increasing popularity of RS, there has been an increase in the number of patients with highly advanced cancer and preoperative chemoradiotherapy, in which it is difficult to secure the field of view due to effusion and bleeding. In such cases, the assistant surgeon often inserts a laparoscopic suction tool through the assistant's port. However, there are many situations in which the straight suction tool hit the sacrum could not reach the bottom of pelvic or in which the suction tool interferes easily with the robotic forceps, preventing effective suction

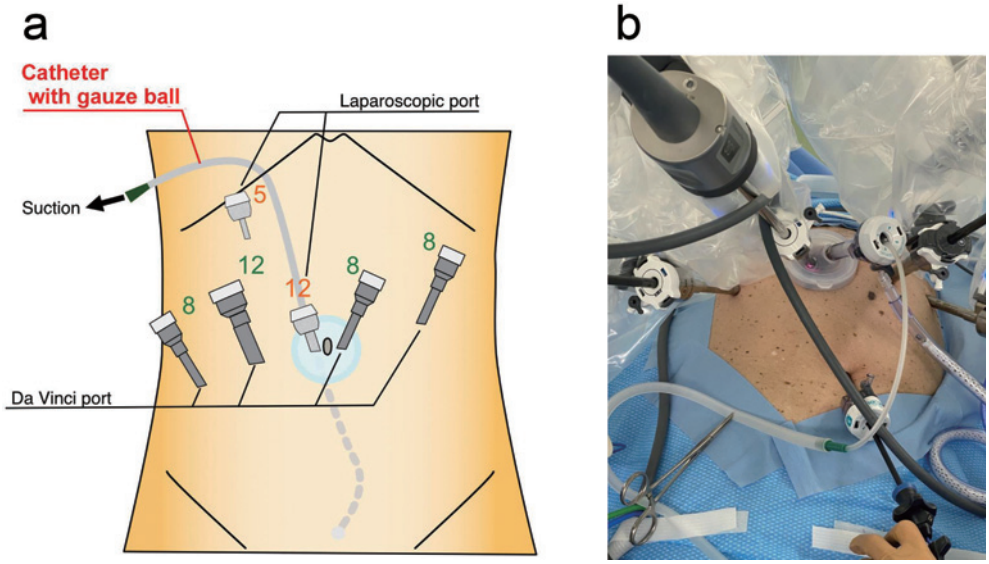

Figure 2. a. Schematic of port and catheter placement. The catheter with attached gauze ball is placed through a 12-mm port and connected to a suction tube; b. The assistant adjusts the suction pressure using Kocher forceps to partially occlude the suction tube.

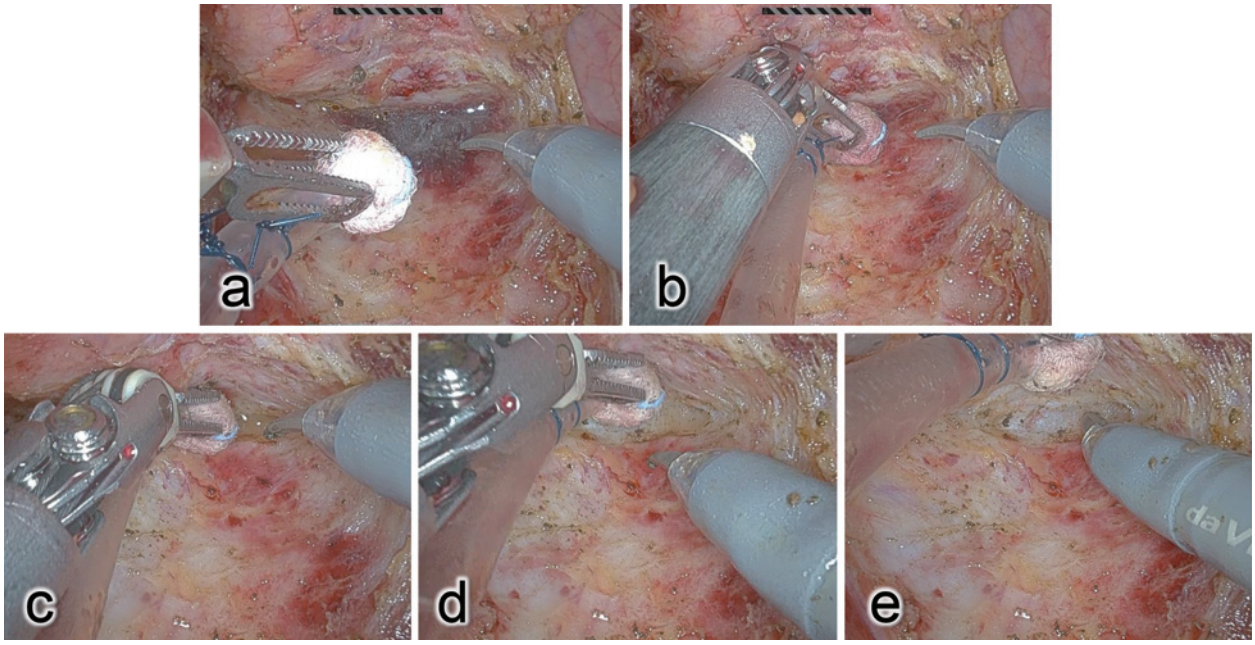

Figure 3. a-b. The console surgeon can grasp the gauze ball and move this catheter for suctioning of effusion fluid and blood without adsorbing the surrounding tissue in the narrow pelvis; c-e. The gauze ball can also be used to push on the pelvic sidewall to widen the surgical field.

(Figure 4a).

Several suctioning methods that use either a remotely operated suction and perfusion system (ROSI)[5], a catheter with a basket-like metal devices attached to the tip[6], or a modified assistant suction tube[7] are reportedly effective, but only for suctioning purposes. Our unique suction system is similar to systems described in these previous reports in that it allows for provision of suction in the narrow pelvic cavity, and it also allows the console surgeon to perform suction independently without relying on an assistant surgeon. However, our method is superior in terms of reliable suction, further enabling surgical field expansion using the gauze ball at the tip of the catheter, and its cost-effectiveness.

Our gauze-tipped catheter does not adsorb surrounding tissue, and it provides efficient suction, thereby securing the

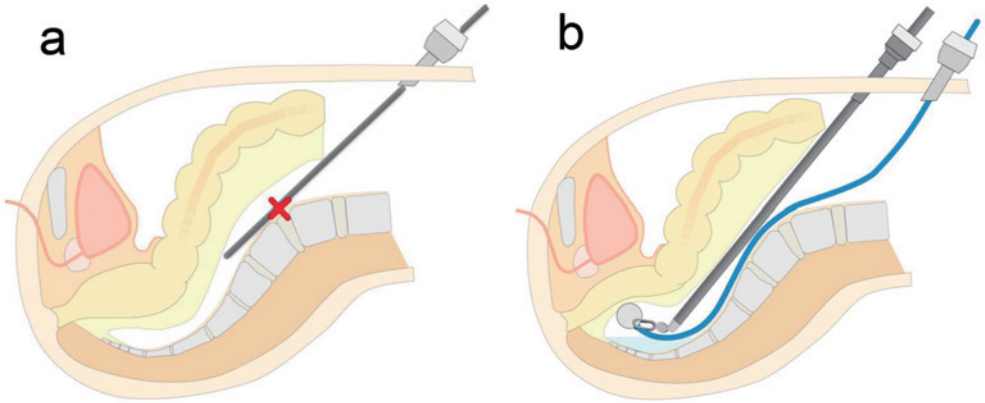

Figure 4. a. The straight suction tools may not reach the bottom of the pelvis beyond the sacrum; b. The gauze-tipped catheter can reach deep into the narrow pelvic cavity and can be used for retraction with robotic forceps.

field of view. Furthermore, it can be used not only for suction, but also for deployment as a tissue retractor within confined spaces, using the gauze's coefficient of friction[8]. By using the gauze ball to apply traction while simultaneously applying retraction around an organ, the exfoliated layer can be more clearly delineated by being able to aspirate exudate without damaging the tissue (Figure 4b). Additionally, the gauze ball can also be immediately used to apply pressure to bleeding sites.

There may be some concern that continuous suctioning would reduce pneumoperitoneum pressure, making it difficult to maintain the operative field. However, maintenance of pneumoperitoneum pressure can be achieved using devices such as the AIRSEAL System or adjustment of the suction units, and alternatively, the assistant is able to adjust the suction pressure using Kocher forceps. Additionally, the da Vinci's remote center technology keeps the abdominal wall in place[9], thereby the effect of continuous suction in the pelvic area is barely noticeable.

Our unique suction system involves inserting a multiport access device (such as EZ Access) into the incision site for specimen retrieval, and attaching a 12 mm port to the device. This allows the catheter to be inserted through the same opening, eliminating the need for additional incisions. Furthermore, our method requires only a suction catheter and a gauze ball and is very inexpensive, making it superior to other methods in terms of cost. In addition, since no special equipment is required, the method can be used for any situation.

Our method does have some limitations. Neither the gauze ball nor the suction catheter deviates from their original use, but since the catheters with the gauze ball are self-made, there is a risk of losing them in the pelvis, even though the gauze ball contains a radio-opaque contrast thread. With a focus on durability and safety, we have meticulously examined the catheter's thickness and gauze ball size to ensure a secure adhesion of the gauze ball to the catheter. Additionally, we have repeatedly made improvements, such as using nylon threads instead of twisted threads that might unravel in wet scenes. However, disseminating this method widely while maintaining quality becomes challenging. Therefore, we are considering the development of integrated products that ensure both durability and safety. Also, one slight concern with our technique is the need for the addition of a 12 mm port. However, as previously mentioned, this concern can be alleviated by using a multiport access device equipped with a 12 mm port. Furthermore, hematomas, for example, cannot be aspirated, and while the effectiveness of this suction system has been well realized, the method has not been formally evaluated.

In conclusion, our suction system allows the surgeon to secure the field of view for robotic surgery using suction and enables compression of tissues and expansion the surgical field using the gauze ball, allowing the surgery to better reflect the surgeon's plan. We believe that this system is useful, not only for robotic rectal surgery, but also for any type of RS that takes place in narrow surgical fields, such as liver and esophageal surgery, thoracic surgery, and even gynecologic and urologic pelvic surgery.

Conflicts of Interest

There are no conflicts of interest.

Author Contributions

HU, HT, TY and TS conceived of the presented method. KW, HU, HT, AK, SH, YF, TY, TS and KS performed the surgery using this method. KW, HU and RO examined the ideas generated through the surgery and developed a better method, and YM and ST supervised the development of this method. KW and HU drafted the manuscript. All authors are equally responsible for all aspects of the report. All authors have read and approved the final manuscript.

Approval by Institutional Review Board (IRB)

All procedures in this study were performed in accordance with the ethical standards of the institutional research committee and with the 1964 Declaration of Helsinki and its later amendments.

Informed Consent

Written informed consent was obtained from all patients.

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