Laparoscopic Treatment for Esophageal Achalasia and Gastro-Esophago-reflex Disease Using Radius Surgical System

Yasumitsu Hirano · Noriyuki Inaki ·
Norihiko Ishikawa · Go Watanabe

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Abstract Radius surgical system (RSS) is a manual manipulator to enhance the surgeon's dexterity and ergonomy achieving more degrees of freedom, and it enables us easy to perform intracorporeal suturing in laparoscopic surgery. We successfully performed laparoscopic treatment including intracorporeal suturing in cases of esophageal achalasia and gastroesophageal reflux disease using RSS. RSS may facilitate of intracorporeal suturing and knotting in complex laparoscopic procedures.

Keywords Radius surgical system · Laparoscopic surgery · Manual manipulator

Introduction

Radius surgical system (RSS) is a manual manipulator developed by Tuebingen Scientific Medical GmbH (Tuebingen, Germany) to enhance the surgeon's dexterity and ergonomy achieving more degrees of freedom. It is a manual forceps that has two additional degrees of freedom: deflection and rotation of the tip. This manipulator enables us easy to perform intracorporeal suturing. We report successfully treated cases of esophageal achalasia and gastroesophageal reflux disease using RSS.

Case Reports

A 59-year-old man presented to our hospital with dysphasia. Upper GI barium study revealed dilatation of the esophagus

(maximum 7 cm) and fixed narrowing in the region of the lower esophagus. Esophagogastrosopy revealed the closed inferior esophageal sphincter, but the scope was passed through the lesion. The diagnosis of esophageal achalasia was established, the laparoscopic Heller myotomy was performed with Toupet fundoplication using the radius surgical system. We could safely perform intracorporeal suturing and knotting without any difficulty owing to this system (Fig. 1). Post-operative course was uneventful, and the patient has remained healthy with no clinical evidence of recurrent disease since then.

A 72-year-old woman presented to our hospital with dyspnea. Computed tomography revealed hiatus hernia which oppressed the left atrial cordis. Upper GI barium study revealed dilatation of the esophagus (maximum 7 cm) and fixed narrowing in the region of the lower esophagus. Esophagogastrosopy revealed the closed inferior esophageal sphincter, but the scope was passed through the lesion. The diagnosis of esophageal achalasia was established, and the laparoscopic Heller myotomy was performed with Toupet fundoplication using RSS. We could safely perform intracorporeal suturing and knotting without any difficulty owing to this system. Post-operative course was uneventful, and the patient has remained healthy with no clinical evidence of recurrent disease since then.

Discussion

Since the introduction of laparoscopic cholecystectomy as the standard treatment for benign gallbladder diseases, laparoscopic surgery has developed further. Numerous reports have provided overwhelming evidence that laparoscopy provides better cosmetic results, less postoperative pain, and shorter recovery time when compared with open surgical procedures

Y. Hirano (✉) · N. Inaki · N. Ishikawa · G. Watanabe
Department of General and Cardiothoracic Surgery,
Kanazawa University Graduate School of Medical Science,
13-1 Takara-machi,
Kanazawa, Ishikawa 920-8641, Japan
e-mail: yasumitsu@yahoo.co.jp

Fig. 1 Toupet fundoplication using radius surgical system—we could safely perform intracorporeal suturing and knotting without any difficulty owing to this system

[1]. In the future, many general surgical operations are likely to be replaced by laparoscopic procedures. However, laparoscopic procedures have many technical problems such as a spatial view, a lack of haptic sense, and the fact that instruments with limited degrees of freedom must be used. The conventional laparoscopic instrument has only four degrees of freedom. It means the movement of instruments is strictly limited in laparoscopic surgery, and it leads that the indications for laparoscopic surgery are also limited. For the further development of laparoscopic surgery, one of the most important aims is to overcome the limited movement of instruments.

Recent advances in the area of medical robotics have been proposed to offer a solution to some of this problem [2–4]. The da Vinci surgical system has a three-dimensional view, tremor abolition, and motion scaling enhancer. These functions assist surgeons in operating smoothly and precisely, and with regard to control of the instrument, surgeons can control the instrument tip in an intuitive way with their fingers and wrist and can produce rapid, precise, and repetitive movements for long time without tremors or fatigue. However, this robotic system is currently too expensive and complicated for common hospitals, and it is unlikely that this robotic system will be of

Fig. 2 Radius surgical system (Tuebingen Scientific Surgical Products GmbH, Tuebingen, Germany): **a** instrument set, **b** deflection, and **c** rotation

significant benefit when applied to most general surgical procedures, especially when cost is taken into consideration.

As a bridge between the conventional laparoscopic instrument and the da Vinci surgical system, RSS has been developed [5, 6]. It is created to enhance the surgeon's dexterity and ergonomics achieving more degrees of freedom. It is a manual forceps that has two additional degrees of freedom: deflection and rotation of the tip (Fig. 2). Waseda et al. [5] reported in his experimental research that RSS could contribute to accurate and controlled needle guidance, especially in difficult spatial situations. Inaki et al. [7] have reported that the introduction of radius is feasible and facilitates the fixation of mesh with sutures in laparoscopic inguinal hernia repair. Torres Bermudez et al. [6] has demonstrated in their study that the feasibility of laparoscopic colorectal sutured anastomosis using RSS, when performed by surgeons well trained in the technique and sutured anastomosis with RSS, is proved to be significantly safer. They have also reported regarding the ergonomics that the use of RSS makes surgeons significantly less discomfort in hand/wrist. Our report is not the experimental study and it is difficult to prove the benefit; however, the above-mentioned studies may reveal the accuracy and feasibility of the suturing in laparoscopic treatment for esophageal achalasia and gastroesophageal reflux disease with RSS. Concerning the learning curve, Frede et al. [8] reported that RSS was easy to use, and they identified a very short learning curve in urology.

But the radius system has limitations compared with the da Vinci surgical system. The instrument tip controlled with the rotation is less intuitive than with the robotic system. The da Vinci surgical system also has a three-dimensional view, tremor abolition, and motion scaling enhancer. These functions assist surgeons in operating smoothly and precisely. Another

problem is that the shaft of radius is currently 10 mm in diameter, which means that we need at least two 10 mm trocars for a pair of radius besides the trocar for an endoscope.

RSS can be an efficient tool to support surgeons performing surgical complex procedures, enabling them to manipulate the instruments accurately and precisely in an ergonomic position without the use of costly robotic systems.

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