Safety, Efficacy and Standardisation of technique of Robotic Nissen Fundoplication for GERD in Versius Robotic platform

Subhash Khanna[1]MS, FRCS(Edn), FARIS; Areendam Barua[1] MS, MCh, FARIS; Ramesh Agarwala[2] MS, FRCS(Edn), FARIS

[1]Department of Minimal Access, GI and Robotic Surgery, Swagat Super Speciality Surgical Institute, Guwahati, Assam, India

[2]Department of GI Surgey, Fortis Hospital, Kolkata

Email - profsubhashkhanna@gmail.com

www.swagathospitals.in

Introduction

With the increasing incidence of GERD (gastro-esophageal reflux disease) worldwide, more surgeons are dealing with it(1). Although South Asian countries have a lower incidence of the disease compared to Western counterparts, the incidence of clinically significant reflux in India is 7.6%, which converts to a huge number having the disease, given India's population(2). Given that 10 – 15% of GERD patients will eventually need surgery for clinically meaningful symptom relief, a large chunk will land up for fundoplication(3). But then not every patient will get relief of symptoms with this surgery, given the demanding technical aspects of the surgery, with proper access, visualisation and maneuvering of surgical instruments being the most challenging aspect.

Although there is no debate that laparoscopic fundoplication is preferred over open fundoplication, there is no definite evidence in favour of robotic fundoplication as against laparoscopic fundoplication. With newer robotic surgery platforms hitting the market, it needs to be seen if the benefits of robotic surgery are carried forward by the new platforms. While robots with multiple independent arms have shown promise (4,5), there is still a paucity of literature regarding their safety and efficacy in various kinds of surgeries. In this study, we wish to assess robotic Nissen fundoplication in the Versius robotic platform.

Materials and methods

All the surgeries were done by a single surgeon with 40 years of surgical experience at a single center in Northeast India. We collected data prospectively from April 2021 to December 2024. 30 cases of robotic fundoplication were included in the study. Records were maintained collectively by CMR staff and our surgical team. Written and informed consent regarding surgery and the use of clinical data was obtained. The Versius surgical system is an open console system with a 3D HD head-up display (HUD) and four independent arms that can be freely placed around the patient's table. Ethical approval for the study was taken from IEC-NECHRI (IEC/04/10-11/2021).

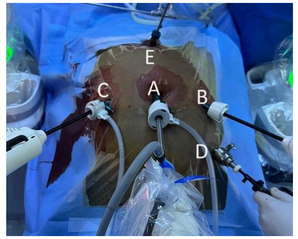
How we do it: The Swagat Super Speciality Surgical Institute and NH experience

Preoperative evaluation: All patients undergo a routine esophagogastroduodenoscopy and Contrast-Enhanced Computed Tomography scan (CECT) with intravenous (IV) and oral contrast. They also undergo all the relevant investigations required for clearance for surgery from Department of Anaesthesiology.

Patient position: The patient is placed in reverse Trendelenburg position of around 15 degrees with the legs split to facilitate placement of a robotic arm in between the legs.

The robotic set up: The setup consists of three robotic ports and two assistant ports. The bedside unit for the robotic endoscope is placed in between the legs and the other two bedside units for instruments are placed on both sides of the patient table. A bipolar Maryland forceps is attached to the bedside unit on the right robotic port. Monopolar scissors are attached to the bedside unit on the left. Two assistants are required on the left of the patient for the two assistant ports. One 5 mm port is placed at the epigastrium for the liver retractor. If the Nathanson retractor is used, we may omit the need for an assistant for liver retraction. Another assistant port is placed between the left 5 mm robotic port and 11 mm camera port, making an isosceles triangle with the distance between the camera port and the assistant port having the same distance as the 5 mm left robotic port and the assistant port. This port is mostly placed just anterior to the anterior axillary line around 3 cm below the level of the umbilicus. This port is used for suctioning and assistance. The camera port is placed around 3 cm above the level of the umbilicus. The left port is taken along the mid-clavicular line at around 1 – 2 cm below the level of the camera port. The right port is taken along the mid-clavicular line around 1 – 2 cm above the level of the umbilicus. In smaller-built patients, the instrument ports may move further laterally to have a distance of at least 6 – 8 cm between the ports.

Surgical steps: The standard surgical steps for fundoplication were used. All patients underwent Nissen's fundoplication with cruroplasty. At least 3 cm of the esophagus was mobilised in each case and also every patient underwent Belsey's fat pad excision. The short gastric arteries were not transected in any of the cases.



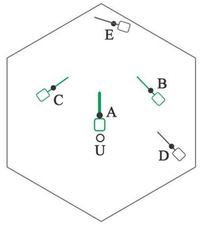


Fig 1 : Robotic port position: A – 11 mm camera port, B – 5 mm left instrument port, C – 5 mm right instrument port, D – 5 mm assistant port for retraction and suctioning, E – 5 mm epigastric instrument port for liver retraction. The position of each of the ports is described in the text.

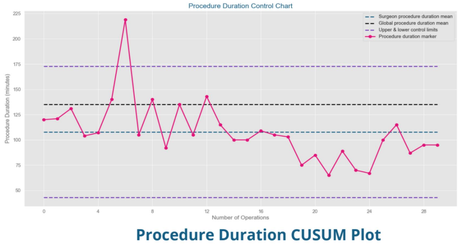


Fig 2: Graph showing duration of surgery of cases 1 – 30 (in mins). Y axis shows time in minutes and X axis shows the procedure number.

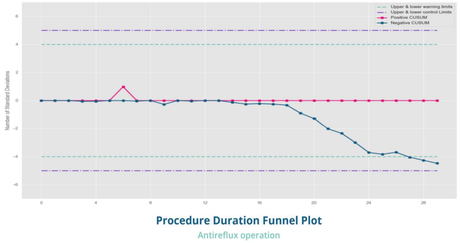


Fig 3: The CUSUM plot suggests a gradual reduction in the time required to perform the fundoplication, indicating a gradual increase in surgical proficiency. From the 14th case to the 18th case, the time reduction is minimal, but afterward, there is a significant reduction in time to do the same surgery, which can only mean the proficiency in doing the surgery is increasing as the operator's skill and time management are getting better with each case.

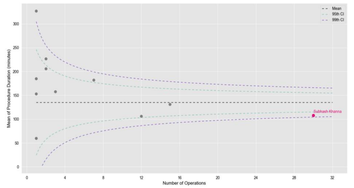


Fig 4: Showing average time taken for the surgeon to complete the procedure of fundoplication in comparison to other surgeons using the Versius robotic platform.

Results

The average age of the patients was 45.7 years with the youngest being 22 years old and the oldest 77 years old. The average BMI of the patients was 24.4 with the lowest being 17.2 and highest being 31.6. The duration of the procedure ranged from 65 mins to 225 mins, with the average duration being 115 mins. There was a significant decrease in the duration of the procedure after the 18th case, and the decrease in duration continued till the 30th case. The setting up time ranged from 3 -12 mins with the average setting up time being 6.3 mins. The blood loss was minimal in most of the cases. No abdominal drains were kept in any of the cases. The duration of hospital stay postoperatively ranged from 3 days to 8 days with the average duration of stay being 4 days. No significant immediate postoperative complications were observed in any of the cases. At the 30th postoperative day, 1 patient had both bloating and dysphagia to solids, while 2 patients had dysphagia only and another 2 patients had bloating only. They all responded to endoscopic balloon dilatation under sedation.

Discussion

With the cost of robotic surgery coming down, thanks to the competition in this field with newer entrants, the number of robotic surgeries being done is steadily going up. More general surgeons, surgical oncologists, thoracic surgeons, and cardiac surgeons are steadily taking it up in addition to urologists and gynaecologists (6). Many studies establish the role of various general surgical procedures in the robotic platform(7–9). There is also ample evidence that the Verisus robotic platform is safe for minimal access surgery in various specialties (9,10).

We used only two instruments robotic arms for the surgery along with the robotic endoscope. The initial few cases took more time than the standard time taken for a case of fundoplication mostly due to instrument clashes and clash with the assistant surgeon that led to alarms going off and due to the need for re-port training, owing to suboptimal port positioning. But then, we improvised on patient position, port position, experimented with assistant port positions and finally we could find a comfortable configuration for the ports and an optimal stance of the robotic arm bedside units for maximum mobility which led to fewer arm clashes at around the 10th case. From the 14th case to the 18th case, the time reduction was minimal, but there was a significant decrease in the duration of the procedure after the 18th case. This decrease in procedure time continued till the 30th case.

Conclusion

Our early results of this study of 30 cases show the safety, feasibility, and effectiveness of fundoplication with the Versius open robotic system. This study also shows the ease of using multiple bedside units that mimic a standard laparoscopic surgery with subtle modifications to avoid arm clashes and to accommodate the assistant surgeon. The duration of surgery, superior dissection, lesser blood loss, absence of any intra-operative complication, or any major machine dysfunction during the procedure is testimony to the fact that it is efficient in carrying out the surgical procedure in the standard technique as described in the above text.

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