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TREATMENT OF THORACIC STOMACH USING A ARTICULATING BIPOLAR VESSEL SEALING SYSTEM

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TREATMENT OF THORACIC STOMACH USING A ARTICULATING BIPOLAR VESSEL SEALING SYSTEM

Keyhole procedure (with the Hiatus oesophageus as key hole)

1. FOREWORD

St. Antonius Hospital Gronau GmbH is a general hospital in Münsterland (Westphalia). The hospital is comprised of six clinics and an inpatient ward, along with state-of-the-art diagnostic radiology and nuclear medicine.

Use of cutting-edge operative techniques (3D laparoscopy) and robotic surgical systems (daVinci surgical robot) are characteristic of the hospital. We began using the daVinci system nearly ten years ago in urological procedures; today, three clinics (urology, gynecology, and general and visceral surgery) work with the system in our Center for Robotic Surgery (CRM).

The St. Antonius Hospital Gronau's General and Visceral Surgery Clinic has 48 beds, and performs around 1,800 general and visceral surgical procedures annually, primarily in laparoscopic form. In the year 2015, 54 diaphragm operations were performed at St. Antonius Hospital Gronau.

2. GENERAL INFORMATION ON THE THORACIC STOMACH

Diaphragm fractures in which portions of the stomach are displaced into the mediastinum are differentiated into three types. The simplest form is the axial hiatal hernia, in which a shortening of the esophagus and an expansion of the diaphragmatic opening result in the stomach shifting intrathoracically to varying degrees. In a paraesophageal hiatal hernia, the esophagus usually reaches the right crus of the diaphragm and is fixed there, while parts of the stomach shift cranially into the thorax and then remain there beside the esophagus. If the stomach becomes completely or almost completely displaced into the mediastinum, it is described as thoracic stomach. Such cases frequently also result in torsion of the stomach around its own axis.

Clinical symptoms of this condition are not uniform. Axial hernias are either asymptomatic or result in development of a gastro-esophageal reflux condition making treatment necessary. Patients with paraesophageal hiatal hernias or thoracic stomach frequently experience pain after eating. The three conditions are very different in terms of whether surgery is indicated. Simple axial hiatus hernia requires no therapy if no symptoms are present. In patients with gastroesophageal reflux disease, treatment is done in stages: first conservatively using medication, then surgically if drug therapy is not sufficiently successful.

With symptomatic paraesophageal hernia or thoracic stomach, gastroesophageal reflux disease is generally not the primary concern. Conservative therapies are usually not successful here. Cases must be assessed individually to determine whether surgery is indicated. In any case, patients with paraesophageal hernias or thoracic stomachs must be examined regularly. As the condition progresses, however, these patients are frequently presented for operative treatment. The primary reasons for this include pain after eating, stomach wall ulcers, or bleeding in the strangulation areas.[1, 2, 3, 4]

3. THORACIC STOMACH SURGERY

Operative treatment of paraesophageal hiatus hernia or thoracic stomach begins with an attempt to reposition the entire stomach down, that is, rectify its displacement in the cranial direction. The force applied here must be carefully metered, and the instruments used must be strictly atraumatic. Supradiaphragmal tissue must not bleed when incisions are made, as hemostasis is hardly possible before the stomach has been repositioned, and visibility will quickly become obstructed. In many of the operations performed here at St. Antonius Hospital Gronau, only partial repositioning of the stomach was possible, such that

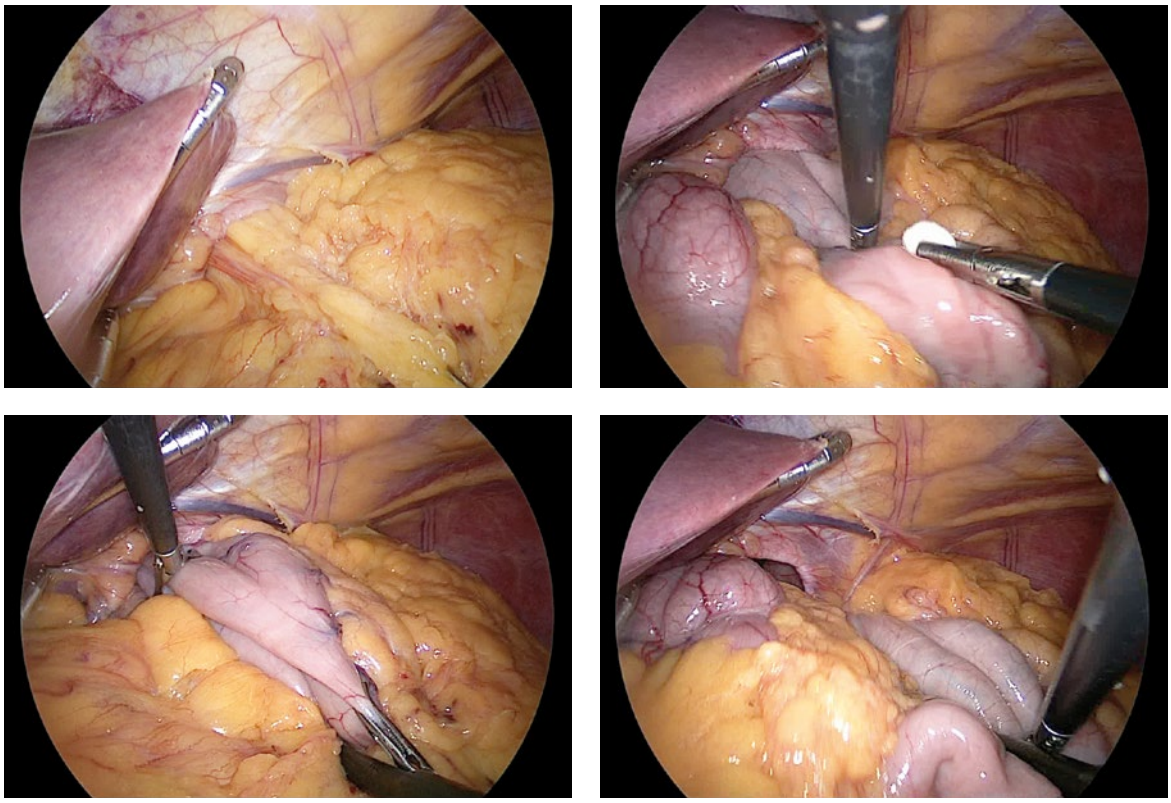

Fig. 1 The pictures show a completely intrathoracic stomach, with parts of the transverse colon and the greater omentum also displaced in the thoracic direction. In such cases, laparoscopic intervention is only possible if the organs can be repositioned from the mediastinum into the abdominal cavity. Cranial fixation renders laparoscopic surgery impossible, as the hernial orifice is blocked despite its significant size.

parts of the stomach remained fixed in a mediastinal position. After repositioning has been completed, the hernia sac is cut at the edge of the hiatus, and then extracted surgically from the mediastinum along with the stomach.

Repositioning the stomach down from the thorax is sometimes easy, but often sharp dissection above the diaphragm is required in order to free the stomach from fibrous adhesions. Once the stomach has been successfully repositioned, the procedure continues with resectioning of the hernial sac, dorsal dissection of the retroesophageal adipoid, and careful mobilization of the cardioesophageal junction as fully as possible. Complete mobilization of the cardioesophageal junction, in particular, is necessary in order to get the esophagus (which often appears shortened at first) into position without tension, about 3 cm in the intra-abdominal direction.

Even after the stomach has been successfully repositioned within the abdominal cavity, this can create significant dissection issues. The hernial sac itself is often enormous; the hernial sac wall inhomogeneous,

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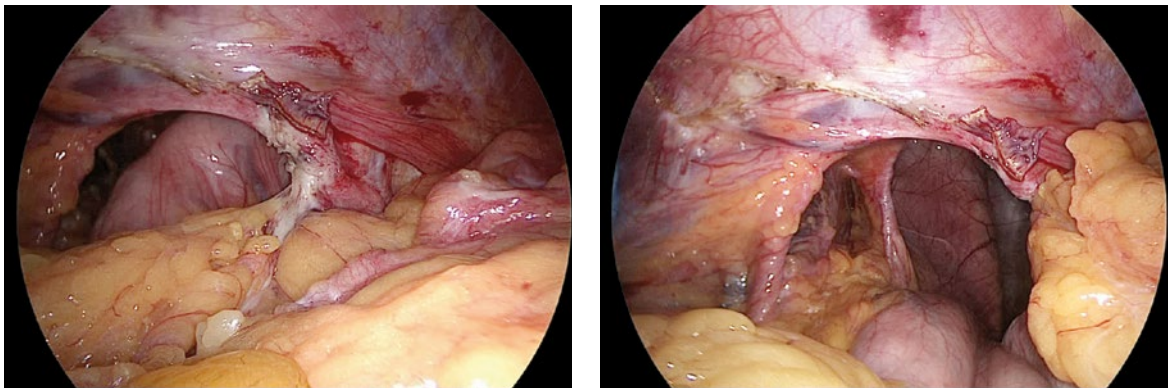

Fig. 2 The hernial sacs in these images are very thick-walled in some cases, and most of them are highly vascularized. The left image shows extensive fibrous fixation of the hernial sac along the edge of the left hiatal flank, which initially had made full mobilization of the stomach impossible. Mobilization could only occur following sharp dissection of the adhesions. The image on the right shows a commonly occurring ventral fold extending between the esophagus and the ventral mediastinum. The figure beside it shows the right side of the hernial sac between the hiatus and the stomach and esophagus.

sometimes very thick and heavily vascularized, and sometimes difficult to differentiate from the stomach and the esophagus. We start by dissecting the hernial sack on the left side by exposing the hiatal flank and continuing with dissection along the front edge of the hiatus. After that, we resect the right side of the hernial sac.

Bleeding in the mediastinal area of operation is particularly problematic during this dissection process, as it can quickly impede visibility. Large left hepatic lobes can also cause difficulties on occasion, if they extend far into the area of operation. If the hepatic lobe is deemed problematic, the lig. teres hepatis, lig. falciforme hepatis and lig. triangulare sinistrum are severed at the very beginning of the operation, so that the left hepatic lobe can be tilted far to the right and then held out of the way relatively easily with a fan retractor.

Organs fixed into place high up within the mediastinum that cannot be repositioned using blunt tools create special difficulties. In principle, dissection of a stomach greatly displaced in the cranial direction within the mediastinum constitutes keyhole surgery, wherein the hernial orifice of the hiatus oesophageus represents the keyhole through which dissection must occur.

Figure 3 shows a large hiatal hernia with the stomach intergrown very high up within the mediastinum. With hernias extending far into the mediastinum and fixed in place there, the two ports used are not positioned ideally for the surgeon. It is nearly impossible to achieve satisfactory angulation for proper dissection because of the hiatus oesophageus, which acts as a keyhole. With the surgical instruments at the desired angle—of about 90° to the hiatus oesophageus—unhindered operation becomes impossible beyond a depth of around 10 cm. As such, the surgeon must keep the instruments in a nearly parallel position. On the one hand, this makes tissue dissection more difficult; on the other, it often means that dissection must take

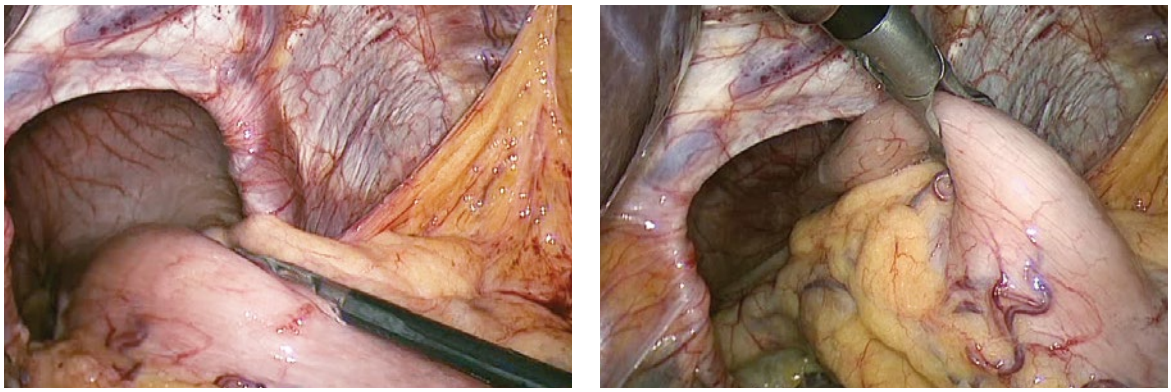

Fig. 3 The thoracic stomach in these images was completely intergrown into the dome of the mediastinum and had to be completely dissected free. In this case, the large diameter of the hiatal hernia was helpful because it allowed the use of standard laparoscopic instruments to dissect the tissue up to the dome of the mediastinum.

place at an angle even around larger blood vessels or convoluted veins, rather than at a right angle as desired (to minimize vessel sealing wound size).

In our own experiences, dissecting with instruments in a near-parallel position also creates far greater stress on the stomach and esophagus to be mobilized than with instruments angled 90°. In some cases where the stomach is positioned very high up within the mediastinum, surgeons may need to consider aborting the procedure or performing a thoracotomy.

In the laparoscopic form of this procedure, instruments with flexible-angle tips are of particular importance, especially when it comes to vessel sealing instruments. Dissecting around the stomach and the esophagus deep within the mediastinum requires constant grasping of both organs. Using straight or only slightly angled instruments to perform deep-level dissection means constantly pulling at either the stomach or the esophagus so that tissue can be dissected and removed laterally, ventrally, and dorsally. This often results in visible dissection marks on the organs being treated, as well as bleeding or injuries. Having such issues go undetected would be disastrous, especially on the esophagus.

Once the thoracic stomach has been completely repositioned and the cardioesophageal junction fully mobilized, treatment proceeds on the basis of the individual anatomical and clinical findings for that patient. We start by reducing the hiatal hernia using a dorsal hiatoplasty in the form of a single interrupted suture using non-absorbable suture material; with very large hernias we sometimes employ a combination of front and rear hiatoplasties. Alloplastic reinforcement is only performed if the crura of the diaphragm are particularly thinned out.

Fundoplication is regularly used to treat thoracic stomach as well; this may be either complete (Nissen cuff) or partial fundoplication, depending on

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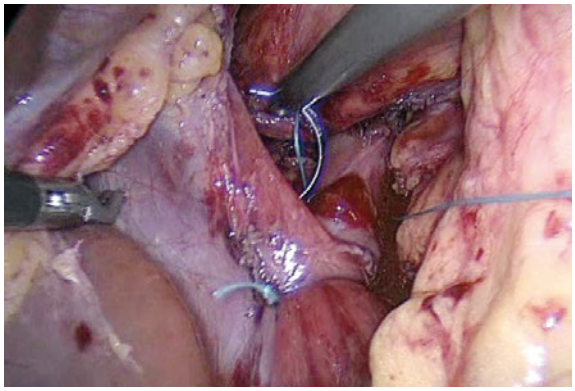

Fig. 4 Dorsal hiatoplasty with strong diaphragm crura.

esophageal function. Fundoplication serves to block reflux, and the wrapped cuff helps stabilize the stomach in a subdiaphragmal position. Supplementary gastro-hiatopexy (suturing the cuff to the right and left crura of the diaphragm) may be performed in certain anatomical situations.

4. USE OF VESSEL SEALING SYSTEMS

Operative treatment of thoracic stomach is not without its share of surgical issues. The stomach torsion and the large flaps of hernial sac tissue require careful management of the dissection process. My own first experiences in treating thoracic stomach using laparoscopic methods date back to the year 1995. Back then, the lig. gastrolinenale and the short gastric vessels were severed by effecting bipolar coagulation and then cutting them with scissors. Laparoscopic dissection was exceptionally difficult in cases of thoracic stomach, as the thick, well-vascularized hernial sacs were extremely difficult to resect. Bipolar coagulation required us to switch instruments constantly, and occasionally also resulted in bleeding if the scissors did not hit the weld seam of the bipolar coagulation precisely.

Ultrasonic technology followed later on, along with various bipolar sealing systems by different manufacturers. We no longer use ultrasonic technology to dissect in very close proximity to the esophagus, primarily due to the high temperatures that develop on the instrument heads.

Bipolar vessel sealing instruments provide secure vessel sealing. The instruments are available with shaft diameters of 5 mm. With these instruments, tissue sealing is followed by a separate tissue removal process, which the surgeon initiates. With large vessels or problematic situations, the surgeon can also perform several sealing procedures in sequence, and then dissect the tissue after that. The disadvantage with most of these instruments is that their heads are fixed-angle.

Since 2013, we have been using the Aesculap® Caiman® system to perform tissue sealing in all types of general and visceral surgery. The Caiman® 5 articulating has been available to us for about six months now. This 5 mm device can be angled underneath the tip by up to 80°.

The activation button on the back of the instruments anatomically shaped handle is well secured against accidental activation. When opened, the instrument can be rotated 360°. The built-in, patented distal-closing rocker ensures good tissue compression within the instrument, and also prevents thicker sections of tissue from slipping out of the instrument.

The rounded plastic coating on the metallic sealing jaws provides exceptional heat insulation. The outer walls of the tip remain cool enough that the instrument can be employed in blunt dissection again immediately after use, so it is not necessary to switch instruments.

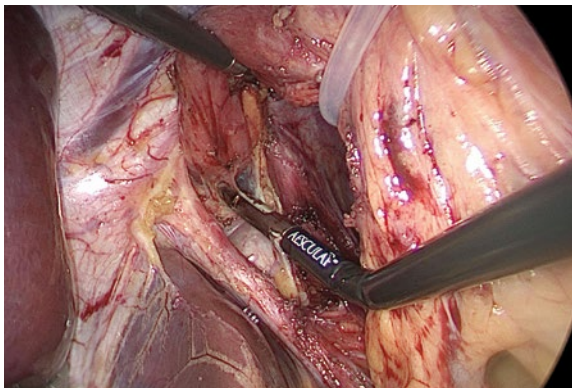

Fig. 5 The Caiman®, a flexible-angle instrument.

5. CONCLUSION

The articulating tip of the new Caiman® instrument allows comfortable, tissue-conserving resection of the often heavily vascularized intrathoracic hernial sac in thoracic stomach operations. In our observations, sealing vessels and vascular bundles was safe and reliable at all times, including with larger veins, which often pose a problem for vessel sealing systems.

Furthermore, the articulating tip of the instrument makes it possible to seal practically any vessel perpendicular to its orientation, ensuring that the area to be sealed remains as short as possible at all times. As such, tissue and especially the often numerous blood vessels can almost always be dissected at a right angle without requiring excessive distention of the hernial sac or the esophagus.

The length of the jaw is beneficial to effective dissection as well. And the atraumatic tip, which allows blunt mobilization without changing instruments, also ensures that the distal esophagus can be mobilized safely. Good thermal insulation is another factor in this regard, as it ensures that the instrument tip does not heat up excessively, as with (for example) ultrasonic scissors.

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