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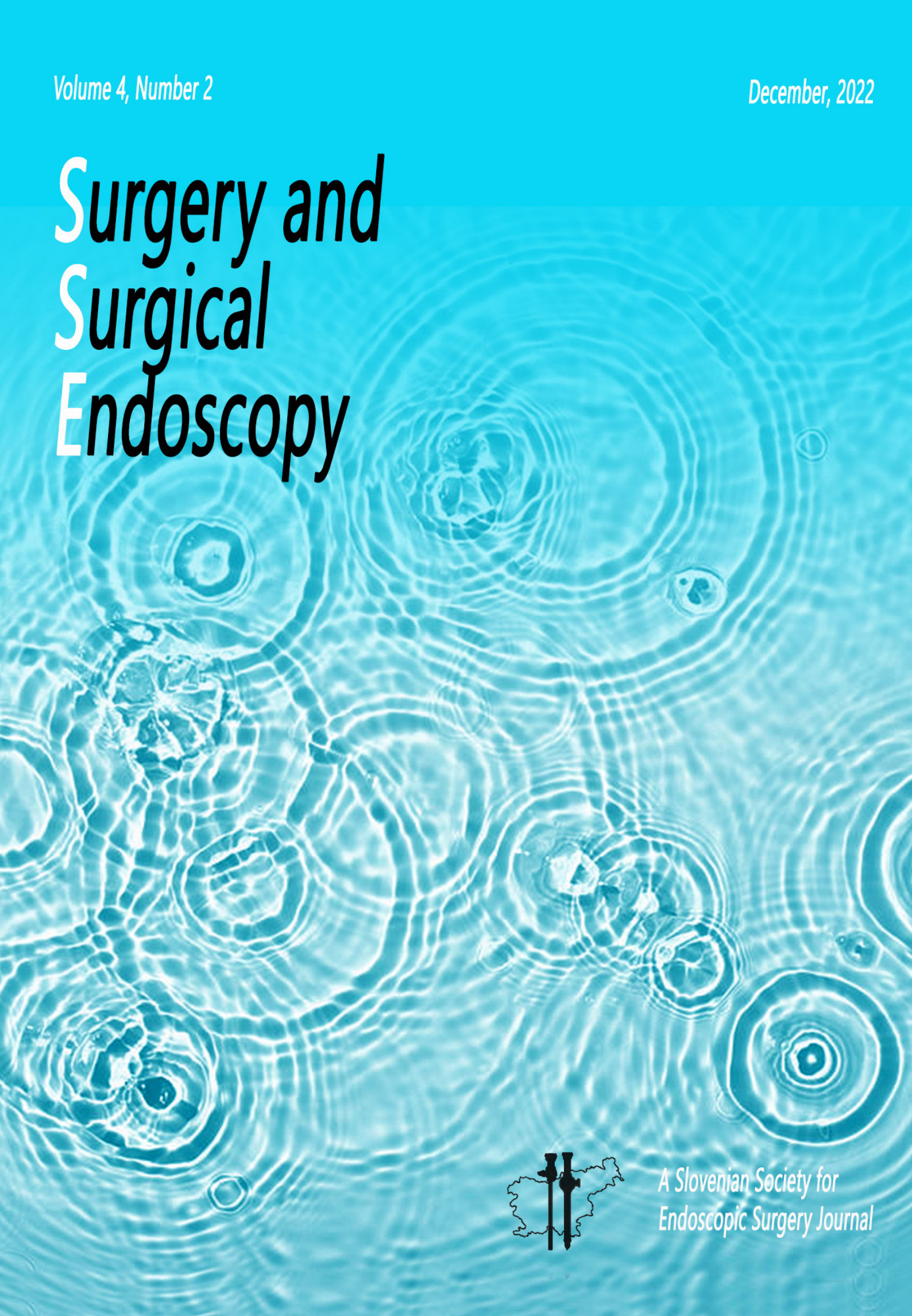

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Impressum

ABOUT THE JOURNAL

Surgery and Surgical Endoscopy is a fully open acces, peer-reviewed journal that aspires to publish articles relevant to surgery, surgical oncology, and surgical endoscopy from researchers worldwide. The journal accepts research articles, review-articles, case reports, letters to the editors, study protocols and “How I do it” submissions. We also publish submissions that accompany educational videos which are published on our official YouTube site.

SSE is the official Journal of the Slovenian Society of Endoscopic Surgery.

All manuscripts must be accompanied by a signed authorship declaration form. Instructions for authors, instructions for submitting videos, authorship declaration form and the description of the peer review process can be found below.

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Surgery and Surgical Endoscopy

December 2022

Editorial

Prof. Bojan Krebs, MD, PhD

Dear friends and colleagues!

I am pleased to present the new issue of Surgery and Surgical Endoscopy. We have been publishing the magazine for 5 years and this is already the 10th issue. We are very proud of the magazine, and the editor-in-chiefs assist. prof. Jagrič and assist. Prof. Groshek and to all of you who send your works and contributions and in this way helped in the development of the magazine and the path along which we will reach the impact factor someday in the future.

In 2022, the Slovenian Association for Endoscopic Surgery elected a new management, which will lead the association and also the journal in the next mandate period. The old management was very successful and ended its fruitful five-year period (due to the epidemic, we extended the mandate) with a very high-profile international congress in Bled.

The new management, which I am chairing, has many important goals and tasks ahead of it.

There are currently approximately 100 members in the Slovenian Association for Endoscopic Surgery. At the European level, this is very good, because, in terms of absolute numbers, we are at about half of all participating countries. Most of our members are from Ljubljana and the surrounding area, and our goal is to recruit members from smaller hospitals and surgical departments throughout Slovenia. It is about the fact that the title Endoscopy Association, both at the European and Slovenian levels, is increasingly losing its strict endoscopy meaning and is becoming primarily a surgical association. Most surgical procedures in the developed world today are performed endoscopically or even with the help of a robot. The development is unstoppable, and in a few years, we will also have to follow this trend with robots here. The management of UMC Ljubljana has recognized the importance of such an approach, and we hope that this will also happen elsewhere in Slovenia.

It is also necessary to take a step forward in the area of the magazine. Interviews are taking place with prominent experts from neighboring countries who will participate in the magazine's editorial board and in this way raise the level, and we will also ask colleagues from abroad to send contributions and help the magazine's international recognition.

In the next four years, we plan to organize two international congresses along with several smaller events. My vision is that two innovations would be implemented at the congress, or things that were already known would be reintroduced. I will do my best to invite other specialties to the congress, such as thoracic surgery, ORL, vascular surgery, or even gynecology. I heard from several colleagues that they would like to participate,

as their associations are even smaller and less organized than ours, and such an event would be an excellent opportunity to exchange opinions and socialize. On the other hand, I would like to bring all doctors to congress, even the rare ones who may not be mainly involved in endoscopy. The topics of open surgery are also extremely important and interesting and have a place in our association and also at the congress.

I look forward to working with you and I hope you will like this issue of the magazine as well!

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Original Article

Evaluation of the Mofixx laparoscope holder in laparoscopic gastrectomy

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Key Words: Mofixx system; laparoscopic gastrectomy; gastric adenocarcinoma

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Abstract

Background: The present paper aims to present the first experiences with the Mofixx system. We presented the general overview of the system placement. To evaluate the Mofixx system, we compared the conventional laparoscopic gastrectomy with the Mofixx laparoscopic gastrectomy system.

Methods: We compared the conventional and the Mofixx system augmented laparoscopic subtotal gastrectomy in patients with gastric adenocarcinoma. With the adobe after effects camera tracking system, we compared the number of loss-of-focus, off-center deviation, involuntary and voluntary camera movements, and camera extraction between both procedures.

Results: With the Mofixx system, the total number of events was four compared to 22 with conventional laparoscopy. During the 2 minutes and 45 seconds clip, no involuntary camera movement was noted with the Mofixx system, while in conventional laparoscopy, five involuntary movements were recorded. Voluntary movements were noted seven times in the hand-held procedure compared to one time with the Mofixx system. Loss-of-focus was registered only with the Mofixx system, and this event occurred only once.

Conclusion: We confirmed that the Mofixx system reduced the number of off-center deviations and voluntary camera movements while the involuntary movements were abolished. The reduced camera movements could potentially shorten the operation and relieve the stress on the surgeon and the assistants.

INTRODUCTION

The advance of minimally invasive surgery has brought forth novel instruments that have allowed more sophisticated laparoscopic interventions [1-4]. Today almost all open surgical procedures have been shown to be feasible with minimally invasive techniques. Meanwhile, most laparoscopic operations are longer than their open surgical counterparts [1-4]. The more prolonged operations put a strain not only on the surgeon but also on the whole surgical team, often forcing surgeons to stay in non-ergonomic positions for hours. Consequently, surgeons lose focus, and errors in these situations are inevitable.

One of the key laparoscopic tasks is camera holding. The assistant operating the laparoscope has the important task of presenting the best operating field view and, at the same time, keeping the point of interest in the center of the optical field. In addition, the assistant's task is to keep the camera lens clean while not impeding the operation. In long-lasting operations, assistants are exposed to stress, making them tired. This can be seen as inadequate operating field exposure, which in turn causes difficult dissection.

Recently novel solutions to laparoscope positioning have been introduced. At the department for abdominal and general surgery in Maribor, we introduced the laparoscope holding system Mofixx. The present paper is aimed at presenting the first experience with the system. We presented the general overview of the system placement. To evaluate the Mofixx system, we compared the conventional laparoscopic gastrectomy with the Mofixx laparoscopic gastrectomy system.

METHODS

PATIENTS

In the present paper, two laparoscopic gastric resections for gastric adenocarcinoma were compared. In both cases, a laparoscopic subtotal gastrectomy with D2 lymphadenectomy was performed. Surgery was performed according to JCGC standards [5]. The laparoscopic procedure was described in detail elsewhere [6, 7].

Patients' informed consent was obtained before surgery. The study was approved by the local Ethics committee (UKC-MB-KME-74/20).

MOFIXX SYSTEM CONFIGURATION

The Mofixx system consists of a surgical table adapter, a flexible arm, a trocar, and a switch connected to the laparoscope. Before draping, the surgeon applied the operating table's adapter and the flexible arm. The general principles of positioning the adapter and the arm in the operating table are as follows: I) the Mofixx system arm attached to the trocar should be orientated to point to the operating field. In this manner, the wide angle of rotation is turned to the operating field, making intraoperative movements of the flexible arm unnecessary; ii) the flexible arm should come to the operating field at a U-curve, so it does not impede the trocar positioning; iii) the adapter should be placed on the table on the side of the patient closest to the trocar allowing the longest bend of the flexible arm; iv) during the introductions of the trocars and during the steps that need extensive camera movements, the trocar should be detached from the flexible arm, allowing a conventional use of the trocar.

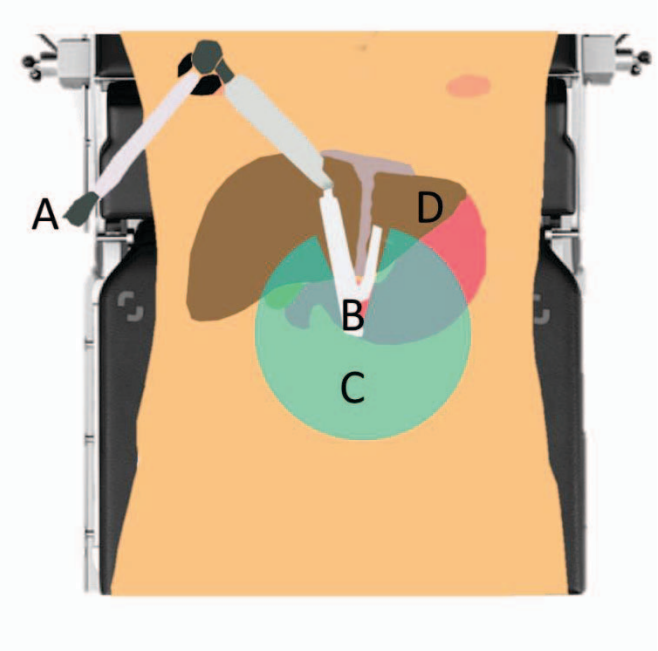

Figure 1. Mofixx system configuration for laparoscopic gastrectomy.

A: Attachment of the Moffix system to operating table; B: Attachment point for the trocar; C: Angle of rotation; D: Operating field.

COMPARISON OF CONVENTIONAL LAPAROSCOPY TO THE MOFIXX SYSTEM AUGMENTED LAPAROSCOPY

A 2 minutes and 45 seconds segment of lymph node dissection video was selected in both patients. We used the videos from the hepatoduodenal dissection step (number 12 lymph node station). This step was selected as it involves meticulous dissection around vessels in the hepatoduodenal ligament when the camera position is critical. Both videos were analyzed with the adobe after effects program (Adobe Systems Incorporated, California, U.S.). The program has an automagical camera tracking function. With this function, the point of dissection was selected and marked. For tracking, a single point on the tip of the active blade of the ultrasonic dissector was selected. In addition to automatic tracing, the video clip was manually checked to correct false tracking due to losing a point on the image. After editing the tracking, the complete tracking path was obtained on a separate layer. An additional layer containing a target with a circular ruler was placed over the video clip and centered on the camera focus. Finally, we counted the number of times the tracking path deviated more than two deviations from the center of the camera focus. In addition, the number of voluntary camera movements, involuntary camera movements, and the number of camera cleanings were counted.

Involuntary camera movement was defined as unnecessary closing-up or moving away from the operating field, visible as the jerky movement of the camera. Voluntary camera movement was defined as the controlled and slow repositioning of the camera to find the center of interest in the operating field. Loss-of-focus was defined as repositioning the camera to bring the operating field back into the center of the view. Off-center-deviation was defined as the deviation of the tip of the active device more than two deviations from the center of the view field. Lastly, the number of camera extractions for lens cleaning was compared between both procedures.

RESULTS

OPERATION

Both patients were comparable regarding their age and sex. The Mofixx patients had a tumor located in the distal third necessitating a distal subtotal gastrectomy with D2 lymphadenectomy, while the patient operated with conventional laparoscopy had a middle third tumor and received a total gastrectomy with D2 lymphadenectomy. All extracted lymph node stations were video documented to ensure that a proper D2 lymphadenectomy was performed. In each case, curative resection was performed. The postoperative course was uneventful in both cases, with no significant deviations between patients.

Table 1. Clinicopathological characteristics and operative results of the patients.

	Mofixx patient	Hand-held camera patient
Age	71	69
Sex	Male	Male
Tumor location	Distal third	Middle third
TNM stage		
T	4a	3
N	0	2
M	0	0
Number of extracted LNs	38	19
Number of positive LNs	0	3
R	0	0
Blood loss		
Less than 300 ml	1	1
More than 300 ml	0	0
Body mass index	25.01	22.76
Type of operation	Lap GST D2	Lap GT D2
Complications yes/no	No	No
VAS		
VAS day 1	6	6
VAS day 2	6	5
VAS day 3	5	5
VAS day 4	5	7
Intravenous analgesics	4	5
First stool	4	5
Drain removal	6	5
Hospital stay	6	8

Table 2. Comparison of conventional laparoscopy to the Mofixx system augmented laparoscopy

	Mofixx system laparoscopy	Hand-held laparoscopy
Off-center deviation [number of movements]	2	10
Loss-of-focus [number of movements]	1	0
Involuntary camera movement [number of movements]	0	5
Voluntary camera correction [number of movements]	1	7
Camera cleaning [number of movements]	0	0

COMPARISON OF CONVENTIONAL LAPAROSCOPY TO THE MOFIXX SYSTEM AUGMENTED LAPAROSCOPY

With the Mofixx system, we noted one loss of focus in the selected sequence, compared to no loss of focus with conventional laparoscopy. During the 2 minutes and 45 seconds clip, no involuntary camera movement was noted with the Mofixx system, while five involuntary movements were noted with the conventional laparoscopy. The camera position was voluntarily corrected only once with the Mofixx system, compared to seven times with a conventional hand-held camera. With the Mofixx system, two off-center deviation events were noted, compared to ten events with conventional laparoscopy. During the complete duration of the lymphadenectomy of the hepatoduodenal ligament, the camera was never extracted for cleaning in both procedures.

DISCUSSION

Precise camera positioning during laparoscopy is one of the most critical tasks of an assistant in

laparoscopy. Therefore, only experienced assistants should be selected for this task in complex laparoscopic procedures like laparoscopic gastrectomy. But even experienced assistants can get tired during lengthy procedures resulting in camera displacements. To relieve the assistant from non-ergonomic positions and allow a better and more consistent exposure, we analyzed the feasibility of the Mofixx laparoscope camera holder in a side-by-side comparison during a laparoscopic gastrectomy with D2 lymphadenectomy. Our analysis confirmed that visual field deviations occurred more often during conventional laparoscopic gastrectomy. In the selected 2 minutes and 45 seconds clip of the number 12 lymph node station dissection, we counted four events with the Mofixx system compared to 22 events with a hand-held laparoscope.

The most prominent feature of the hand-held laparoscope was the number of loss-of-focus events. With the Mofixx system, only two such events were noted compared to ten with the conventional laparoscopy. The loss-of-focus events occur mainly because the assistant focuses on the point of interest in the center of the operating field. At the same time, the surgeon, during the dissection, constantly moved with the active hand. When the assistant noticed that the surgeon's attention was elsewhere in the operating field, the assistant moved the camera after a short lag. Voluntary movements of the camera followed. The voluntary camera movements were noted as the second leading event. There were seven such movements in the hand-held procedure compared to none with the Mofixx system. This shows that loss-of-focus distracted the assistant and forced him into unnecessary camera repositions. Meanwhile, the surgeon has to constantly follow the field of interest away from the center of the monitor as the camera drifts away. These adjustments are straining for the surgeon as the point of interest continually shifts from the center of the monitor toward the periphery and back. This also highlights those camera movements aimed at catching up with the tip of the active instrument are most of the time unnecessary and lead to distraction of the surgeon. The Mofixx system has a crucial advantage. It steadily holds the camera's position while the surgeon moves tissue into the center of the field of view during dissection. The operating field stays steady, allowing the surgeon's eyes to rest in a single position.

We noted that involuntary camera movements occurred more often during conventional laparoscopic gastrectomy. These were noted especially towards the end of the surgical step of the lymphadenectomy of the hepatoduodenal ligament. Presumably, this occurred because the assistant was forced to hold one position while tiering the arm mussels. With the Mofixx system, no involuntary movements were noted.

With the Mofixx system, we noted one loss-of-focus event, while no such event was registered during the hand-held procedure. As reported before, the assistant is constantly repositioning the exposition of the operating field; hence loss of focus occurs less frequently. Still, there were significantly fewer loss-of-focus events with the Mofixx system, as would be expected. In addition, the event occurred only briefly and had no significant impact on the length of the surgical step.

Finally, the sum of all events was significantly higher in the hand-held procedure. While it is debatable whether the sheer number of events was responsible for longer operating times, they certainly did have a straining effect on the surgeon. The surgeon had to adapt to the ever-changing exposure more often during conventional laparoscopy, leading to fatigue and errors.

Of note, while not the subject of the analysis, we noted that the hepatoduodenal dissection was

performed in a shorter time frame with the Mofixx system compared to conventional laparoscopy. However, this cannot be directly compared based on the findings of two selected procedures because one case could have involved more difficult anatomical dissection than the other. This should be the subject of further studies and larger patient groups.

In conclusion, the present study evaluated the Mofixx system with a side-by-side comparison to conventional laparoscopic gastrectomy. We confirmed that the Mofixx system reduced the number of loss-field and voluntary camera movements while the involuntary movements were abolished entirely. The need for camera repositioning occurred only once and only with the Mofixx system; however, the loss of time was neglectable as the duration of the lymph node dissection was shorter compared to conventional laparoscopy. The Mofixx system relieved the surgeon and the assistant allowing a better focus on the surgery itself.

STATEMENTS AND DECLARATIONS

Competing Interests: Not applicable.

Funding: Not applicable.

Acknowledgments: Not applicable.

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study. Written informed consent has been obtained from the patient(s) to publish this paper"

Ethics approval: The study was approved by the local ethics committee.

Conflicts of Interest: None declared.

Consent for publication: Not applicable.

REFERENCES

1. Katai H, Mizusawa J, Katayama H, et.al. Short-term surgical outcomes from a phase III study of laparoscopy-assisted versus open distal gastrectomy with nodal dissection for clinical stage IA/IB gastric cancer: Japan Clinical Oncology Group Study JCOG0912. Gastric Cancer, 2017; 20:699–708. doi:10.1007/s10120-016-0646-9.

2. Kim W, Kim HH, Han SU, Kim MC, et al. Decreased morbidity of Laparoscopic distal gastrectomy compared with open distal gastrectomy for stage I gastric cancer. Short-term outcomes from a multicenter randomized controlled trial (KLASS-01). Annals of Surgery, 2016: 263(1): 28-35.

3. Yu J, Huang C, Sun Y, et. al. Effect of Laparoscopic vs. Open Distal Gastrectomy on 3-Year Disease-Free Survival in Patients with Locally Advanced Gastric Cancer The CLASS-01 Randomized Clinical Trial. JAMA, 2019; 321(20): 1983-1992. doi:10.1001/jama.2019.5359.

4. Van der Wielen N, Straatman J, Daams F, et al. Open versus minimally invasive total gastrectomy after neoadjuvant chemotherapy: results of a European randomized trial. Gastric Cancer, 2021; 24:258–271.doi::https://doi.org/10.1007/s10120-020-01109-w.

5. Japanese Gastric Cancer Association. Japanese gastric cancer treatment guidelines 2014 (ver. 4). Gastric Cancer, 2017; 20(1):1-19. doi: 10.1007/s10120-016-0622-4.

6. Jagric T. The impact of modifying the laparoscopic lymphadenectomy technique on the extent of lymphadenectomy in laparoscopically operated gastric cancer patients. A single-center study. Surgery and Surgical Endoscopy, 2019; 1(1): 19-25.

7. Jagric T. East meets West: the initial results of laparoscopic gastric cancer resections with Eastern

principles in a single Western centre - a propensity score-matched study. Langenbecks Arch Surg, 2021. doi: 10.1007/s00423-021-02283-w.

Surgery and Surgical Endoscopy

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Original article

Laparoscopic ventriculoperitoneal drainage insertion in patients with normotensive hydrocephalus

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Key Words: ventriculoperitioneal drainage; normotensive hydrocephalus; surgery;

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Abstract

Ventriculoperitoneal drainage is a broadly recognized technique for normal pressure hydrocephalus treatment. With the introduction of minimally invasive surgery, laparoscopy is frequently used in shunt surgery. We present the pathophysiology of normal pressure hydrocephalus and our series of thirteen patients treated with laparoscopically guided ventriculoperitoneal drainage.

no statistically significant difference in symptoms between SIBO positive and SIBO negative group. Conclusion: SIBO is common after bariatric surgery procedures, especially after RYGB, reaching up to 83 % in symptomatic patients. Symptoms does not differ significantly from altered gut solely, therefore glucose breathing tests (GBT) are useful diagnostic tool for SIBO. Because of its prevalence, involvement in other disease states, exacerbation of other diseases and influence on the quality of life it is important to diagnose SIBO after such procedures.

INTRODUCTION

Hydrocephalus is defined as accumulation of cerebrospinal fluid (CSF) in the ventricular system due to imbalance between its formation and resorption [1]. As a result, the cerebral ventricles dilate. The incidence of hydrocephalus in population has been described between 0.41 %

and 2.94 % and occurs more often in patients older than 65 years. Usually, it is caused due to increased CSF production or impaired resorption in the context of various diseases. It may, however, occur also for no apparent reason, which is called idiopathic hydrocephalus [2].

In normal pressure hydrocephalus, the values of CSF pressure stand within the normal range. In tension hydrocephalus, on the other hand, an increase in intracranial pressure due to CSF collection leads to neurological disorders [3]. These may be manifested by typical signs and symptoms, a so called a trias, including the gait disturbance with apraxia, incontinence and neuropsychiatric disorders, which are often incorrectly diagnosed as dementia [1,2].

In conjunction with the history and the neurological examination, the computer tomography (CT) and magnetic resonance imaging (MRI) are most widely used imaging techniques for the diagnosis. They demonstrate expansion of the ventricular system with preserved subarachnoid spaces surrounding the brain. Additionally, neuropsychiatric tests may be implemented and are very useful for confirming he diagnosis [1,4].

The basis of hydrocephalus treatment is CSF drainage and a consequent relief of the ventricular system, which usually leads to clinical improvement. Two types of drainages may be used: I) external and internal drainages and II) ventricular and lumbar drainages. Both types of drainages, internal and external, are used to reduce the elevated intracranial pressure. The internal drainages include the ventriculoatrial, lumboperitoneal and ventriculoperitoneal drainages that are most commonly used in clinical practice, especially the latter one. The external drainages are most frequently used in the context of treatment of severe head injuries. A special endoscopic technique for hydrocephalus management is endoscopic third ventriculostomy, where an opening is made in the front wall of the third ventricle, allowing the CSF to circulate normally [4-6].

For chronic hydrocephalus treatment, the ventriculoperitoneal drainage (VP-drainage) is most commonly used technique, allowing the bypass of excessive CSF, which is not absorbed by the normal physiological routes [5-7]. The insertion of the peritoneal catheter into the abdominal cavity normally requires laparotomy with dissection of the rectus abdominis muscle at the catheter entry point into the peritoneal cavity. An alternative approach is laparoscopy, which is a good alternative to the conventional surgery. This technique was first described in 1993 [8]. With the laparoscopic insertion of the abdominal catheter, surgically induced tissue damage is reduced, since this technique is less invasive, quicker and safer. It allows direct examination of the abdominal cavity, proper placement of the abdominal part of the catheter under a direct vision and inspection of its function. There are fewer complications reported in comparison to the laparotomy, where various surgical complications occur. These have been described in about 12 % of patients. Especially common are the complications during and after the abdominal part of the operation. The additional advantages of laparoscopy also include a better cosmetic effect, a quicker establishment of peristalsis and easier and faster postoperative recovery [7-9]. In this article, we describe a series of thirteen patients, who were treated in the university medical centres in Ljubljana and Maribor due to idiopathic normal pressure hydrocephalus and where the VP-drainage was inserted laparoscopically.

PATIENTS AND METHODS

There were thirteen patients included in the prospective study from 2012 to 2013 with the diagnosis of idiopathic normal pressure hydrocephalus. All patients were treated at the two neurosurgical centres in Slovenia, University

Medical Centre Ljubljana and University Medical Centre Maribor. Before the operation, all patients had undergone standard general and neurological examination, ophthalmological assessment with fundoscopy, neuropsychological tests (Mini-Mental State Examination and Montreal Cognitive Assessment Test) and probatory lumbar puncture. The tests of cognitive ability (neuropsychological tests) were also performed after the surgery and then during the follow-up. The probatory lumbar puncture transiently improved the neurological symptoms in all patients; hence, the VP-drainage insertion was indicated. The patients with cortical atrophy and resultant *hydrocephalus ex vacuo* and those with a negative effect of the lumbar puncture were not included in the study.

The diagnosis was set clinically and confirmed with appropriate imaging, employing CT and MRI, as well as neuropsychological tests. The CT imaging of the head, which was the most widely used imaging modality in our group of patients, revealed dilated ventricular system with or without periventricular lucence and the subarachnoid spaces of normal width. The MRI followed. The radiological working diagnosis was consistent with normal pressure hydrocephalus (Figure 1).

The standard (classical) operative procedure for hydrocephalus treatment, which is usually performed, is a classical surgical VP-drainage insertion. It consists of I) the cranial part of the operation with a burr hole and ventricular catheter placement and its connection onto the valve, and II) the abdominal part, including the subcutaneous tunnelling of the catheter and its insertion into the peritoneal cavity via the laparotomy. In our group of patients, we experimentally inserted the drainage laparoscopically, since this procedure is regarded to be less invasive and faster. Six men and seven women were included in the study. The mean age was 47 years (ranging from 38 to 56 years).

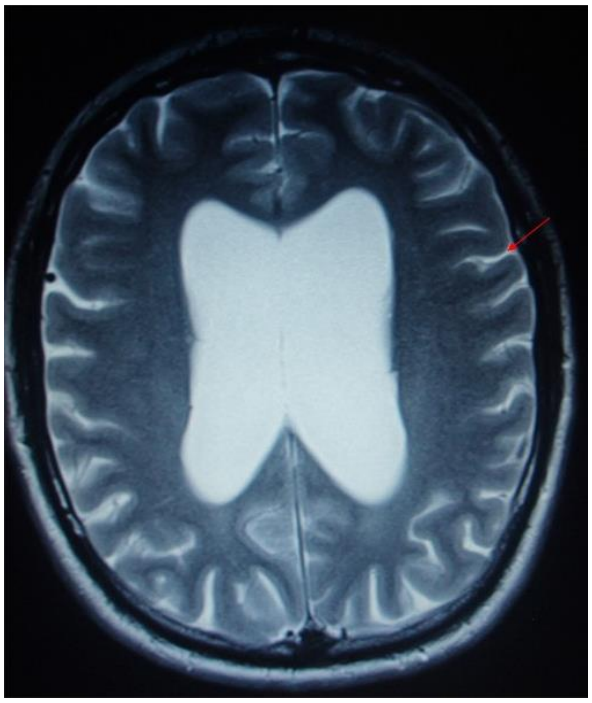

Figure 1. CT scan of a dilated ventricular system

The patient was positioned supine, in the same position as for the insertion of the VP-drainage with laparotomy. The surgical procedure consisted of the cranial part, which was carried out classically, with a burr hole, ventricular puncture and connection of the ventricular catheter onto the middle-pressure valve (Pudenz valve was used). After the dura was opened, the occipital horn of the right lateral ventricle was punctured with the cranial part of the catheter (the ventricular catheter), which was inserted 4 cm to 5 cm deep into the ventricle. The CSF flowed under moderate pressure. The ventricular catheter was then connected to the valve. Then, after tunnelling the subcutaneous tissue, the abdominal catheter was drawn from the head to the abdomen. From here on, the further procedure was performed laparoscopically (Figure 2). A semi-circular skin incision was made above the umbilicus and the abdominal cavity was directly punctured with a Veress needle. For better visualisation, the pneumoperitoneum was established during the insertion. The inflation of the abdominal cavity was done with carbon dioxide up to 12 mmHg, the

Figure 2A

Figure 2B

Veress needle was replaced with a 5 mm diameter trocar and the laparoscope was introduced into the peritoneal cavity (Figures 2 and 3). The carbon dioxide inflation was only needed in the first three patients. In others, the insertion was done without abdominal inflation. After visualisation and inspection of the peritoneal cavity, we selected the position for the intraperitoneal part of the abdominal catheter, which was aimed to be placed in the lower pelvis. After testing the function of the drainage valve and the drainage ports at the peritoneal catheter, the peritoneum was punctured under direct laparoscopic guidance with a peel-off needle. Through this needle, the peritoneal catheter was inserted into the abdominal cavity and placed in the right lower quadrant of the

abdominal cavity by videoscopy through an endoscope previously inserted through the supraumbilical incision. The pneumoperitoneum was released and the catheter was tested again by pressing on the valve and confirming by videoscopy the flow of CSF into the abdominal cavity. The peel-off needle and the laparoscope were removed (Figure 4) and then the abdominal fascia, the subcutaneous tissue and skin were closed in layers.

Figure 3C

Figure 3A

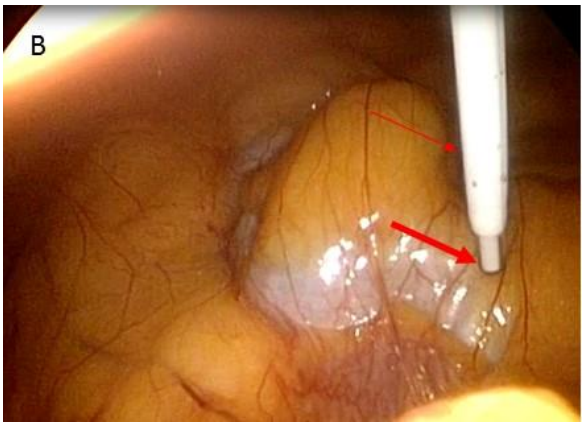

Figure 3B

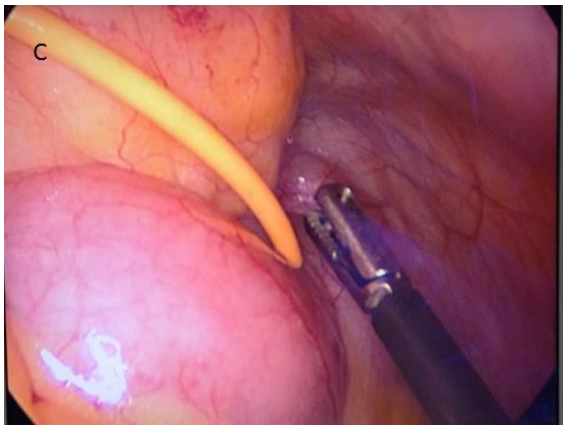

Figure 3C

Figure 3D

Results

The patients' history, findings of the neurological examination and diagnostic imaging were consistent with the diagnosis of idiopathic normal pressure hydrocephalus and the VP-drainage placement with a middle-pressure valve was carried out. A clear cause of the disease was not found. In nine patients, the VP-drainage was inserted for the first time. In the remaining four patients that were operated on, the first

Figure 4

procedures were done through laparotomy. Due to shunt malfunction, a second operation was needed and the laparoscopy was chosen. This approach was preferred to facilitate the insertion of the abdominal catheter due to the scars and adhesions after the previous operation.

The surgery went smoothly for all included patients. The total operating time ranged from 45 to 55 minutes. The surgery involving the abdominal part took from 15 to 25 minutes. After the surgery, the recovery of all patients was insignificant. In eleven patients, the drainage system worked normally. A CT was used for the confirmation of the catheter position in the ventricles and X-rays for the position of the abdominal catheter. As a result of poor drainage, the valve did not drain properly in two patients and a revision of the ventricular catheter was needed due to its misplacement. There were no intracranial or abdominal complications and the wounds were healing by primary intention.

The control CT imaging of the head was done the next day after the surgery and demonstrated an appropriate position of the ventricular catheter. In two patients, however, the ventricular part of the catheter was misplaced. It was ending in the brain parenchyma. These two patients were then reoperated and the position of the catheter was corrected. The X-ray of the abdomen confirmed a good position of the abdominal catheter in all patients. In the majority of patients, it was located in the right upper abdominal quadrant and others low in the pelvis.

The hospitalization lasted from two to five days (five days in the two patients with the revision of the ventricular catheter due to the surgical malposition). No infections were observed and all wounds were healing with the first intention.

DISCUSSION

The idiopathic normal pressure hydrocephalus is usually treated with a VP-drainage placement [9,10]. The disease is characterized by a so-called trias of clinical signs and symptoms, which are not always present and may be joined by other, nonspecific signs [14]. The disease may often mimic other neurodegenerative disorders and the patient selection for treatment of idiopathic normal pressure hydrocephalus with a VP-drainage is therefore not an easy task since the results cannot always be reliably predicted. After surgery, the patients may respond to the CSF drainage with a variable improvement in their neurological status. Especially in the elderly, the neuropsychiatric disturbances, when present, may not only be attributed to CSF accumulation. Moreover, the accurate diagnostic criteria for idiopathic normal pressure hydrocephalus are not precisely clear and the diagnosis is therefore based particularly on clinical grounds [1,11,12]. Some surgeons even say that 'one knows it when one does it', meaning that only when the patient was operated on and the drainage was inserted, the actual clinical effect of the drainage can be appreciated. According to reports from the literature, the improvement of neurological status after a permanent CSF drainage may significantly improve in 29 % of patients and 60 % of patients, but only a partial improvement may be observed [11,13].

Hydrocephalus may result as a consequence of various underlying pathologies, such as subarachnoid haemorrhage, brain trauma, supportive meningitis, brain tumours or neurosurgical operations. In opposite to high-pressure hydrocephalus, where decompression with drainage is essential in a short time, the clinical signs and symptoms in normal pressure hydrocephalus evolve slowly and are less dramatic [1,3,4]. In our group of patients that were operated on, no clear causes for hydrocephalus were recognized according to the medical history, clinical examination and imaging. The diagnosis was therefore consistent with the idiopathic normal pressure hydrocephalus.

A standard practice in Slovenia so far was a classical approach for a VP-drainage placement, which included laparotomy. Although small, this incision was usually longer than 5 cm and incorporated all layers of the abdominal wall. Our series of patients, although small, was the first one that included a laparoscopic approach, which is a standard practice worldwide. According to the data from the literature, describing lesser invasiveness and quicker recovery, we decided to implement laparoscopic surgery, which has proved successful. This technique was chosen particularly due to the minimally invasive approach to the abdominal cavity, lower likelihood of surgical and general postoperative complications, better cosmetic effect and faster recovery. As a result of its numerous advantages in comparison to laparotomy, the laparoscopic technique has lowered the frequency of complications from 34 % to 4 % [8,10,11,14,15]. The laparoscopic technique is quick, minimally invasive and effective, which enables accurate placement of the abdominal catheter under direct visualisation and thereby reduces the risk of catheter position outside the peritoneum. The surgery is carried out without major damage to the abdominal wall. It also enables direct verification of the catheter patency and *in situ* function, which is especially important in those patients, with intraabdominal adhesions. The duration of the operation is shorter, and blood loss and postoperative pain are lower, which facilitates faster mobilisation and recovery of patients. Consequently, the hospitals stay is shorter. There are fewer abdominal complications, such as adhesions in the peritoneal cavity, disturbances in peristalsis, liquor pseudocyst formation and postoperative herniations [8,16,17]. The technique may also be used in paediatric neurosurgery [16]. Since the time of laparoscopic surgery is shorter than compared to laparotomy, there is also a lower risk of intraoperative infection [8,18,19]. In our group of patients, the operation time was on average 45 to 55 minutes, compared to laparotomy interventions, which were usually 10 to 15 minutes longer. According to the literature, the laparoscopic technique is a safe and efficient method for both first insertions and the revisions of the VP-drainages [8,10,13]. These findings were also confirmed in our patients.

CONCLUSION

It was found in this study that the laparoscopic insertion of VP-drainage was successful. It is therefore recommended as a suitable technique for the treatment of hydrocephalus. As a result of the minimal invasiveness of the laparoscopic approach, it is particularly suitable for elderly patients and those with adhesions in the abdominal cavity. Additionally, the cosmetic effects of this surgery cannot be overlooked. In comparison to laparotomy, the laparoscopic method is distinguished by shorter duration of the operation, lesser invasiveness, a lower chance of complications and faster recovery of patients.

STATEMENTS AND DECLARATIONS

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Informed Consent Statement: Informed consent was obtained from all subjects involved in the study. Written informed consent has been obtained from the patient(s) to publish this paper.

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References

1. Hurley RA, Bradley WG Jr, Latifi HT, Taber KH. Normal pressure hydrocephalus: significance of MRI in a potentially treatable dementia. J Neuropsychiatry Clin Neurosci. 1999;11:297-300.

2. Conn HO. Normal pressure hydrocephalus (NPH): more about NPH by a physician who is the patient. Clin Med. 2011;11:162-5.

3. Gautschi OP, Cadosch D, Stienen M, Hildebrandt G, Fournier JY. Idiopathic normal pressure hydrocephalus. Praxis (Bern 1994). 2009;98:893-902.

4. Finney GR. Normal pressure hydrocephalus. Int Rev Neurobiol. 2009;84:263-81.

5. Chung JJ, Yu JS, Kim JH, Nam SJ, Kim MJ. Intraabdominal complications secondary to ventriculoperitoneal shunts: CT findings and review of the literature. AJR Am J Roentgenol. 2009;193:1311-7.

6. Savitz MH, Katz SS. Ventriculosubgaleal shunting for acute head trauma. Crit Care Med. 1983;11:290-2.

7. Kausch W. Die Behandlung des Hydrocephalus der kleinen Kinder. Arch Kiln Chir. 1908;87:709-96.

8. Park YS, Park IS, Park KB, Lee CH, Hwang SH, Han JW. Laparotomy versus Laparoscopic Placement of Distal Catheter in Ventriculoperitoneal Shunt Procedure. J Korean Neurosurg Soc. 2010;48:325-9.

9. Verrees M, Selman WR. Management of normal pressure hydrocephalus. Am Fam Physician. 2004;70:1071-8.

10. Raysi Dehcordi S, De Tommasi C, Ricci A, Marzi S, Ruscitti C, Amicucci G, et al. Laparoscopy-assisted ventriculoperitoneal shunt surgery: personal experience and review of the literature. Neurosurg Rev. 2011;34:363-71.

11. Hebb AO, Cusimano MD. Idiopathic normal pressure hydrocephalus: a systematic review of diagnosis and outcome. Neurosurgery. 2001;49:1166-86.

12. Rakovec-Felser Z, Planinc S, Matvoz M, Vidovic L. Preparing patients to undergo surgery. Acta medico-biotechnica. 2015;8(2):39-51.

13. Jindal A, Mahapatra AK. Correlation of ventricular size and transcranial Doppler findings before and after ventricular peritoneal shunt in patients with hydrocephalus: prospective study of 35 patients. J Neurol Neurosurg Psychiatry. 1998;65:269-71.

14. Vrhovec L. Evidence-based medicine. Acta medico-biotechnica. 2010;3(2):7-8.

15. Pahor D. Slovenia's contribution to world medical research. Acta medico-biotechnica. 2009;2:7-9.

16. Johnson BW, Pimpalwar A. Laparoscopic-assisted placement of ventriculo-peritoneal shunt tips in children with multiple previous open abdominal ventriculo-peritoneal shunt surgeries. Eur J Pediatr Surg. 2009;19:79-82.

17. Sekula RF Jr, Marchan EM, Oh MY, Kim DK, Frederickson AM, Pelz G, et al. Laparoscopically assisted peritoneal shunt insertion for hydrocephalus. Br J Neurosurg. 2009;23:439-42.

18. Taskovska D, Flis V. Incidence of surgical site infections in a tertiary hospital in Slovenia. Acta medico-biotechnica. 2015;8(1):27-34.

19. Spazzapan P, Perosa N, Velnar T. Surgical Treatment of Pediatric Hydrocephalus: Lessons Learned at the Ljubljana University Medical Center. Surgery Surg Endos. 2022;4(1):33-39

Surgery and Surgical Endoscopy

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Original article

How I Do It: Umbilical hernia and rectus abdominis muscle diastasis repair with the Da Vinci Xi robotic platform

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Key Words: umbilical hernia, diastasis recti, da Vinci Xi

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Abstract

When present concomitantly, both umbilical hernia and rectus abdominis muscle diastasis should be operated on simultaneously during the index procedure. Many surgical approaches have been described. So far, there has not been a clear consensus regarding the surgical approach. Patients' goals also differ between groups: esthetic in younger women and functional in less young men. Minimally invasive techniques also include robotic operations, which are gaining popularity and acceptance. Practice at our institution is described.

INTRODUCTION

In 2021 EHS published the guidelines on managing rectus diastasis [1]. Diastasis is defined as the separation of more than 2cm between the rectus abdominis muscles. All treatment options of surgical repair – open/laparoscopic, mesh/plication only, absorbable/non-absorbable suture – can be used for repair. However, plication only is recommended when no hernia is present, while a mesh repair should be used when a concomitant hernia defect larger than one cm is present. Described techniques of repair in the guidelines when a hernia is also present are as follows:

- Endoscopic subcutaneous dissection with plication and onlay mesh technique (SVAWD – subcutaneous video surgery for abdominal wall defects, SCOLA - subcutaneous

onlay laparoscopic approach, REPA – preaponeurotic endoscopic repair, ELAR plus – endoscopic assisted linea alba reconstruction in

combination with mesh augmentation, MILAR – minimally invasive linea alba reconstruction)

- Endoscopic dissection with plication and sublay mesh technique (TESAR – total endoscopic sublay anterior repair, Carrara and co-workers described modification with stapling of rectus sheaths, Bellido et al. described a technique of preperitoneal mesh with plication of both aponeurosis)

- Open dissection with sublay mesh technique

- Open dissection with onlay mesh

All of the above will undoubtedly have even more distinct variations in the future as techniques are still evolving and individual surgeons do many modifications.

EHS umbilical hernia guidelines from 2020 recommend that the preferred operation should be minimally invasive in the event of a more significant hernia defect. Moreover, this approach is recommended whenever there is an increased risk of skin infection [2]. Additionally, it should be noted that a recommendation was given that any defect larger than 1 cm should be repaired with a non-absorbable mesh, extraperitoneal placement of mesh is to be preferred over IPOM with a mesh overlap of at least three or even five cm, has to be achieved.

Rectus muscle diastasis is, by many surgeons, considered to be a risk factor for the recurrence of hernia after operative repair. The data regarding this topic needs to be clarified as diastasis is not routinely reported with the umbilical repair. Correlation is shown in some studies [3] but not others [4]. One can appreciate the surgical logic that diastatic linea alba offers poor quality for suturing because a stretch (Figure 1) in it is present, and sutures cannot be held adequately with every take, only adding to tears and increasing tension opposite to it and thus making good long-term results unsatisfactory.

Cosmesis must also be considered, as many different procedures offer different approaches, each with accompanying distinct skin scars. Minimally invasive techniques offer a better option as port site scars are the minor wounds possible if any operation is to be considered. Another strategy for achieving optimal cosmetic results is to hide the scars, which usually means combining abdominal wall repair with abdominoplasty. This can also be done in two separate, distinct procedures. Yet another angle of controversy comes from the perspective of medical insurance reimbursement, as rectus muscle diastasis may not be considered an actual pathology by insurance providers and, thus, not usually covered by them.

As this pathology has two main goals – functional and cosmetic – patients can be managed by plastic or abdominal wall surgeons. On one side, plastic surgeon may take on self-paying patients with primary pathology in the abdominal wall, which is not their primary domain, and young female patients with primarily abdominal wall pathology may coerce/persuade abdominal wall surgeons into operating when their primary concern is cosmetic with both described options potentially yielding suboptimal results.

The below-described modification of the technique is practiced at our institution. The procedure was developed as an extension of the TARUP robotic umbilical hernia repair technique. Similar to our procedure, the technique has recently been published by Cuccurullo et al. [5] and presented at the 2022 Robotic Abdominal Wall Surgery congress in Ghent with good results reported. The author also recommended using non-absorbable sutures in the plication of linea alba as the only recurrence in their review was observed with absorbable sutures.

In our opinion, this technique combines many of the theoretical best practices in hernia surgery: minimally invasive procedures, which are known to have less infectious complications and shorter time to discharge, good cosmesis or at least almost no additional cosmetic hindrances, placement of large mesh in mechanically more desirable retrorectus space, extensive mesh overlap, complete exposure of linea alba under direct vision with potential exposure of additional subclinical previous unrecognized hernias, optimal placement of sutures and gradual tensioning facilitated with robotics platforms enhanced dexterity and superior vision.

PREOPERATIVE PLANNING

Patients receive a full standard preoperative workup per standard institutional practice before any abdominal open/laparoscopic operation. Clinical examination and patient history are obtained during the initial workup. CT scan of the abdomen is not mandatory; however, it is highly preferable, at least with obese patients, or whenever the clinical examination is inconclusive regarding rectal diastasis. Ultrasound may also be of use. Patient consent is obtained – the operative course is discussed, the pitfalls of placing foreign materials and operative hazards are explained, postoperative behavior instructions are given, and patients' expectations are managed regarding the postoperative cosmesis.

PREOPERATIVE PROCEDURE, PORT PLACEMENT, AND PATIENT POSITIONING

The following procedure is described with the use of the DaVinci Xi platform.

The procedure is done in general anesthesia with endotracheal intubation. A Foley catheter and nasogastric tube are inserted.

Generally, the patient's left side of the abdomen is used as the side of port placement, and the following setup is described in this manner. Reverse positioning may be used in cases where left positioning is not preferable.

The patient is positioned supine on the operating table with an anti-slip mat underneath. At least the left arm is tucked at the body, but both arms preferably. The operative table is positioned in a slight right tilt with legs tilted downward to get some hip extension to minimize the possible conflicts of robotic arms with the patient and lengthen the abdominal wall space for port placement between the rib cage and pelvis. Ultrasound may be used to mark the skin with a pen at the left linea semilunaris when its location is doubtful. Da Vinci patient cart is put in sterile drapes and positioned on the patient's right side. The surgeon's assistant and operative nurse are positioned on the patient's left side. Intravenous Cefazolin is given prior to incision.

OPERATIVE COURSE

The patient is draped, and the bony prominences are marked with a sterile marker. Pneumoperitoneum is achieved through a small incision and Veress needle at Palmer's point three cm below the costal margin in the left mid-clavicular (Figure 2).

Standard eight mm robotic Xi platform ports with blunt tips are used. A five mm port (sometimes twelve mm Airseal port) can also be introduced for the bedside assistant. Ports should be positioned on an imaginary straight line as far laterally on the patient's left side as deemed possible in the cephalocaudal direction, minimally 3–4 cm laterally to linea semilunaris. (Figure 3) Some tilting away from the cephalocaudal axis may be necessary to space the ports following the manufacturer's instructions of at least 4 cm between them, as the space between the costal margin and pelvis may be constrained. An additional assistant port may be inserted in the same line to constitute the 4th port or in a triangular fashion between any two ports laterally to the primary port line.

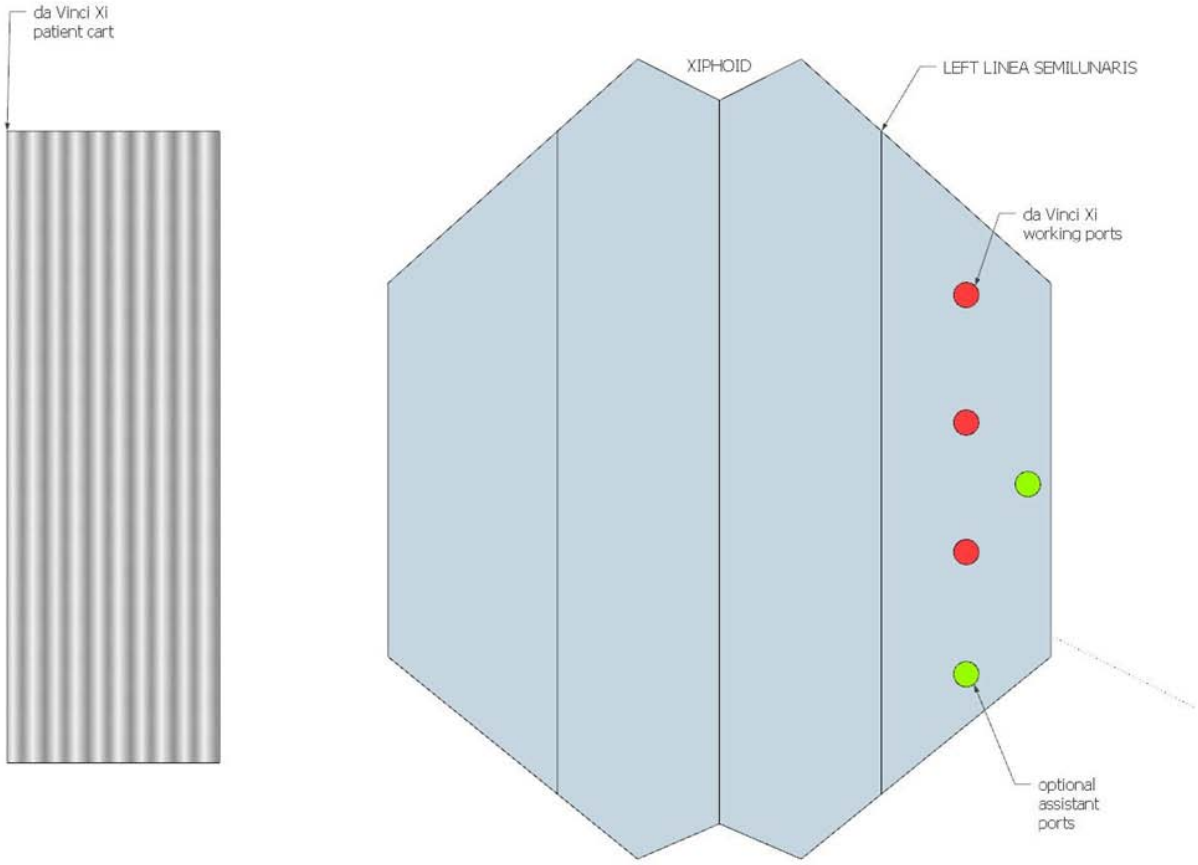

Figure 1. Port placement

PORTS

First, the superior port is usually positioned intraperitoneally blindly, and the other two are under direct vision. The Veress needle is left in place until visual inspection of the needle's course can be evaluated under direct vision, and potential damage during its entry is excluded (Figure 3).

After laparoscopy, the da Vinci Xi systems patient cart is docked and targeted to the position of the hernia (Figure 4). Instruments used in the procedure are the bipolar forceps and scissors, with the latter being exchanged for a needle driver during the procedure.

EXPOSURE

Contents of the hernia are reduced, and in slim patients, the degree and extension of the diastasis may even be evaluated at this point. A needle is placed transperitoneal in a perpendicular fashion to the skin by the assistant 1–2 cm medially to the semilunar line in three places along the vertical line parallel to the semilunar line. In this way, injury to the nerves in the lateral side of the rectus sheath is avoided. This marks the point of entry into the posterior rectus sheath. Entry of the left posterior rectus sheath is performed, and previous needle marks are joined with a combination of sharp dissection and electrocautery (Figure 5). The muscle is mainly bluntly retracted away from the posterior lamella of the internal oblique, which constitutes a posterior rectus sheath above and below the hernia to encircle the hernia. The posterior rectus sheath of the left rectus abdominis muscle is again divided (Figure 6) on the medial border of the rectus sheath both below and above the umbilical

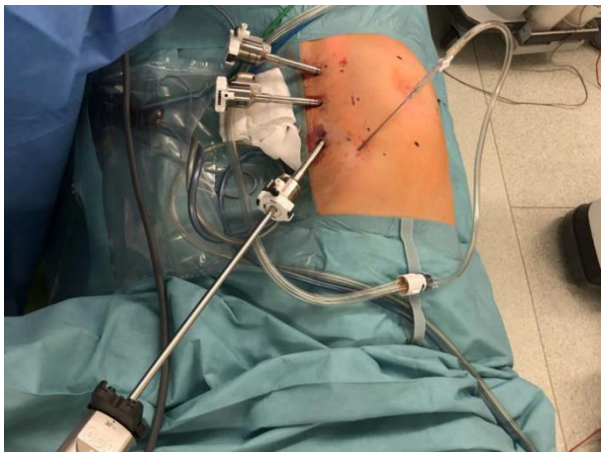

Figure 2. ports inserted, Veress needle inserted at Palmer's point

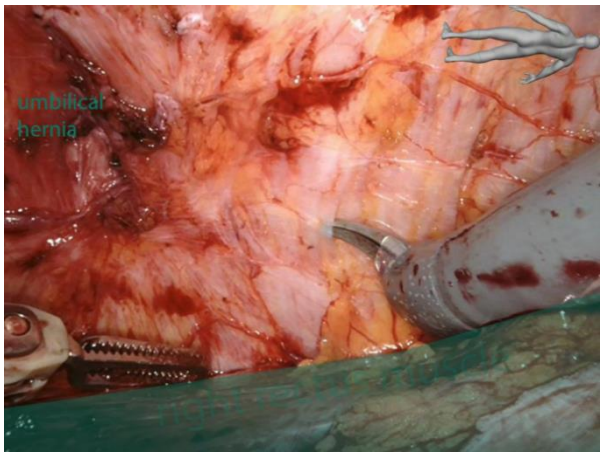

Figure 3. inferior quality of connective tissue with diastatic linea alba, scissors showing microtears

Figure 4. Docked robot at ports

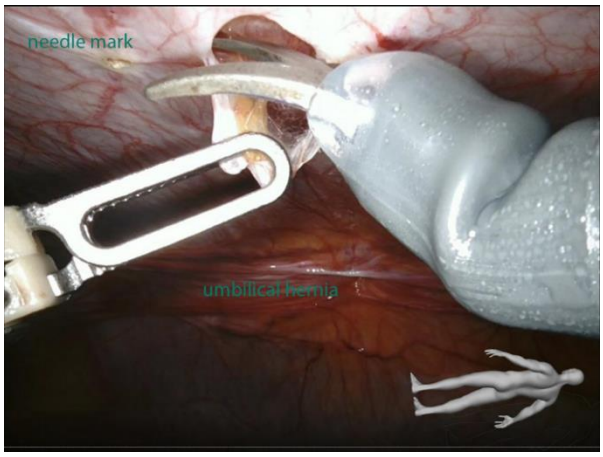

Figure 5. Lateral entry incision in the left rectus sheath

hernia. Care is taken to avoid linea alba injury. In this way, access to the preperitoneal space is obtained. Linea alba is cleared of fatty tissue, and the medial right rectus sheath is exposed. The incision in the right rectus abdominis muscle sheath is then performed both below and above the hernia ("crossover maneuver") (Figure 7). The peritoneum of the umbilical hernia is now reduced while ensuring not to damage it in the process. Smaller holes in the peritoneum are closed with absorbable sutures. The whole diastatic linea alba is now completely cleared of preperitoneal fat, and the right rectus muscle is elevated from its posterior rectus sheath (Figure 8). Care is taken not to injure the epigastric vessels; linea semicircularis may also be divided on the left side when necessary. The diastatic linea alba is, at this time, fully exposed. It is even further cleared to account for the planned mesh overlap margin.

This marks the end of the exposure part of the operation, and a reconstructive phase ensues.

RECONSTRUCTION

The diastatic linea alba is oversewn with a nonabsorbable suture and an umbilical hernia defect (Figure 9). Intrabdominal pressure may be decreased at this point to as low as 8 mm Hg to mediate tension on the suture line. Barbed

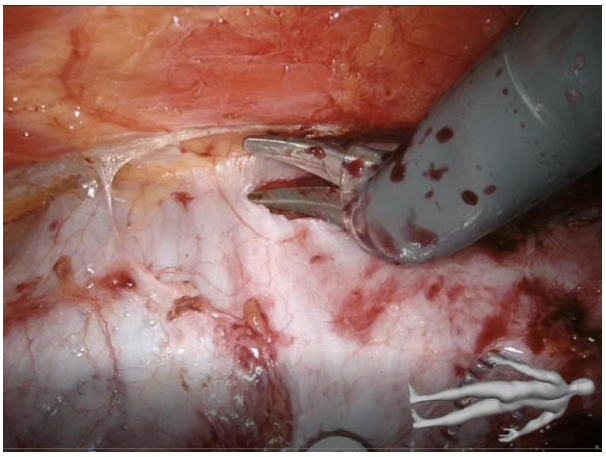

Figure 6. Medial division of posterior rectus sheath retracted rectus muscle visible in the upper part of the picture.

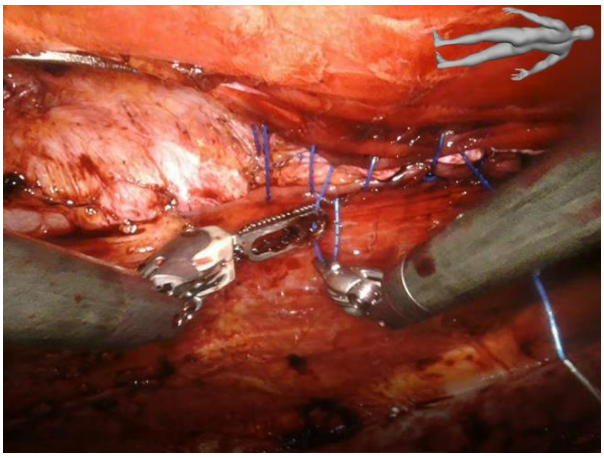

Figure 9. Suturing linea alba with gradual tensioning of barbed suture

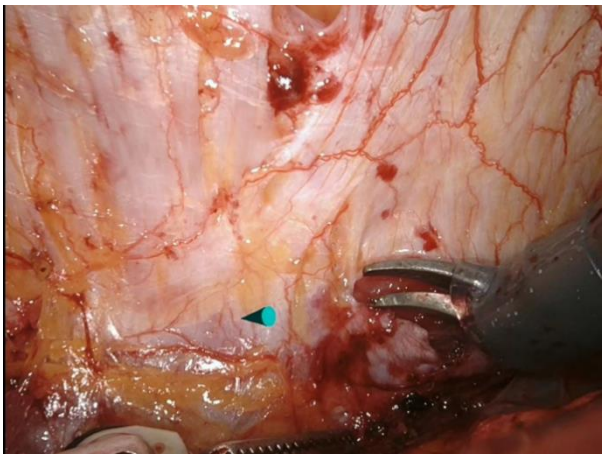

Figure 7. Incision of right medial rectus sheath to complete the "crossover maneuver".

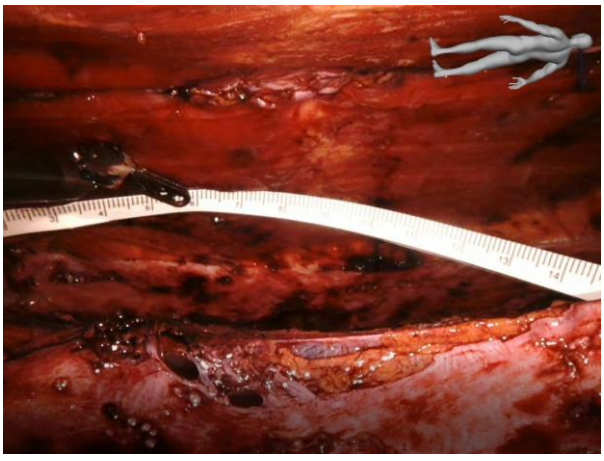

Figure 10. Measurement for mesh size

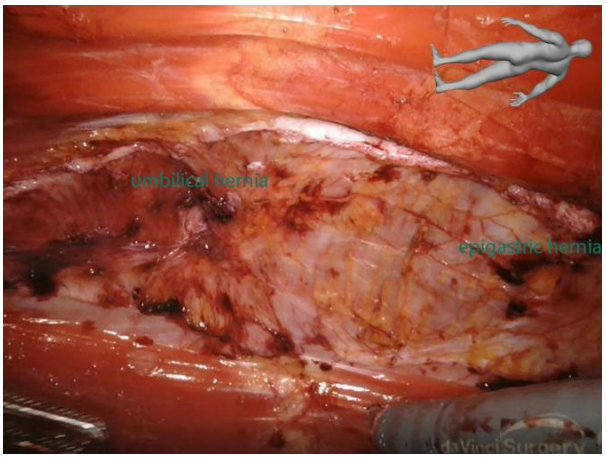

Figure 8. Cleared linea alba with another epigastric hernia found after preperitoneal dissection

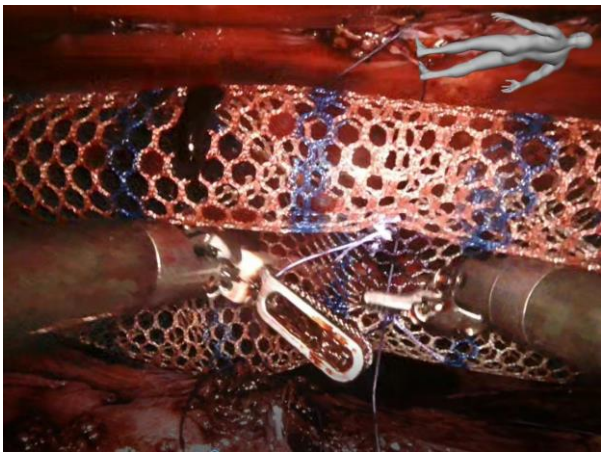

Figure 11. Positioning of the mesh

nonabsorbable suture is used (0 or 1 V-Loc™). The whole length of the suture is run before the tension is sequentially and gradually applied across its length. This way, the approximation of both rectus muscle sheaths is done in a manner that distributes tension across a few sutures. The hernia defect is closed with the same barbed running suture by continuation.

Hemostasis is checked, making sure there is no bleeding. Next, a paper ruler is inserted into the abdominal cavity either through the assist port or through a working port of the platform, temporarily disconnecting the instrument from the robot (picture 10).

A non-absorbable mesh is fashioned according to the measurements gained intracorporeally. The mesh can then be folded in a double roll-up fashion with ends temporarily sutured together. A centrally placed suture can also be tied to the mesh with the needle left in place. This facilitates easier handling intracorporeally. Mesh is inserted through any port and cephalo-caudally oriented. The previously centrally tied suture with the still attached needle is now tied to the linea alba centrally to elevate the mesh to linea alba – also referred to as the "chandeliering" of the mesh (Figure 11). Previous mesh sutures are now cut, and mesh is unfolded from its double roll-up. The final placing of the mesh is now performed, and the mesh is fixated at cardinal points with a few stay sutures, which are relatively loosely tightened only to keep the mesh in its intended place and to prevent mash wrinkling (picture 12). Typically, Vicryl® 4-0 is used.

After the mesh is appropriately positioned with sutures, hemostasis is rechecked.

Any holes in the peritoneum and/or posterior rectus muscle sheath are now closed using either Vicryl® 3.0 or V-Loc™ 3.0 absorbable suture. This ensures that no mesh is exposed intraperitoneally. Finally, the opened lateral posterior left rectus sheath is closed with a continuous 3-0 V-Loc™ suture (picture 13).

After disconnecting one of the robotic arms, the assistant can insert a suction tube in the last take of the continuous suture to aspirate all of the CO2 around the mesh and fuse it with the posterior layer. This maneuver may expose any previously undetected holes in the peritoneum, which are closed if found.

POSTOPERATIVE CARE

The abdominal binder is used right after the operation. Alternatively, the patient's abdomen can be wrapped in bed sheets exchanged as soon as they arrive in the surgical ward. Standard pain medication and parenteral treatment are given after the operation, with oral fluids in the evening of the operative day. On the first postoperative day, solid foods are started, and parenteral medication is discontinued. Patients are mobilized first under the supervision of physiotherapists to achieve full ambulation. Discharge is planned for the second postoperative day. The use of an abdominal binder is advised for one month.

CONCLUSION

Robotic hernia and diastasis repairs expand the borders of minimally invasive hernia surgery. Further popularity and implementation of this technique will elucidate the actual objective advantages of this kind of approach. Subjectively the 7 degrees of movement freedom (especially the wrist action) and the enhanced vision of the robotic platform offer a significant advantage to the surgeon in the execution of these operations, with expected benefits for the patients. Robotics definitely expands the limits of possible minimally invasive surgery.

So far, six cases of umbilical hernia repair have been performed at our institution, with two also having the diastasis recti plicated with promising early results and remarkable patient satisfaction.

The described procedure offers a perfect option for the repair of this pathology. It enables plication repair of the diastasis with mesh reinforcement from the "inside". It also does not violate any additional undamaged tissue in the process, which means that the already widened linea alba is not further damaged in the process. The only drawback to this technique seems to be the aesthetic part. Some degree of wrinkling of the midline skin above the plicated diastasis can be observed in some patients. Even when open abdominoplasty is done concomitantly with diastasis repair, the mesh cannot be placed in the mechanically advantageous retrorectus plane without violating the already diastatic linea alba. In this sense, perhaps a better strategy is first to perform the hernia/diastasis repair and the abdominoplasty afterward.

STATEMENTS AND DECLARATIONS

Competing Interests: Not applicable.

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Informed Consent Statement: Informed consent was obtained from all subjects involved in the study. Written informed consent has been obtained from the patient(s) to publish this paper.

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Conflicts of Interest: None declared.

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REFERENCES

1. Hernández-Granados P, Henriksen NA, Berrevoet F, et al. European Hernia Society guidelines on management of rectus diastasis. Br. J. Surg. 2021 Oct;108(10):1189-91.

2. Henriksen NA, Montgomery A, Kaufmann R, et al. Guidelines for treatment of umbilical and epigastric hernias from the European Hernia Society and Americas Hernia Society. Br. J. Surg. 2020 Feb;107(3):171-90.

3. Nishihara Y, Asami M, Shimada T, et al. Comorbid rectus abdominis diastasis is a risk factor for recurrence of umbilical hernia in Japanese patients. Asian J. Endosc. Surg. 2021 Jul;14(3):368-72.

4. Mannion J, Hamed MK, Negi R, et al. Umbilical hernia repair and recurrence: need for a clinical trial?. BMC Surg. 2021 Dec;21(1):1-7.

5. Cuccurullo D, Guerriero L, Mazzoni G, et al. Robotic transabdominal retromuscular rectus diastasis (r-TARRD) repair: a new approach. Hernia. 2022 Jan 4:1-9.

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Surgery and Surgical Endoscopy

December 2022

Original article

Vesicovaginal fistula repair using robot assisted laparoscopic transabdominal approach: Case report

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Key Words: incontinence, vesicovaginal fistula, robotic surgery, cystoscopy, voiding cystourethrogram

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Article info

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Abstract

A vesicovaginal fistula (VVF) can represent a very debilitating condition for the patient. It should be promptly recognized and treated in the most efficient way. In this article we are presenting a case report of VVF, describing the diagnostic workup and step-by-step management. A robot-assisted laparoscopic transabdominal fistula repair was performed in this specific scenario. We believe that minimally invasive surgery is an excellent treatment option in selected cases of VVF and that it should be taken into consideration by surgeons who are familiar with robotic surgery.

INTRODUCTION

A vesicovaginal fistula (VVF) is a pathological connection between the urinary bladder and the vagina. It is the most common type of acquired fistula of the urinary tract. It has been known since the ancient Egyptian era [1,2,3]. The incidence and etiology of VVF vary geographically. In the developing countries, the predominant cause of VVF is prolonged obstructed labor as a result of poor-quality obstetric care, staff unaccountability, late referral, and poor nursing standards [1,4]. In the developed world, iatrogenic injury of the bladder during pelvic surgery is the most common cause of VVF. It occurs most commonly as a complication of hysterectomy for benign conditions (60-75%), hysterectomy for malignant conditions (30%) and as complication of caesarean sections (6%) [1]. VVF can also arise after radiation therapy and more rarely as a result of forgotten foreign bodies in the vagina (e.g. sex toys, pessaries, etc.) [4].

The predominant symptom of VVF is continuous and uncontrolled leakage of urine from the vagina. In the majority of cases, it is constant, but it could also be intermittent or position-dependent, usually occurring after pelvic surgery. It is debilitating for the patient and can be a cause of considerable distress [4,5]. VVF can be identified by pelvic

examination. If the diagnosis is not clear, we can perform the instillation of vital blue dye into the bladder per urethra and observe the discoloration of the vaginal drainage or the presence of the blue dye on the gauze previously packed in the vagina. The absence of this phenomenon suggests the presence of a ureterovaginal fistula. Cystoscopy should also be performed because it can reveal not only the presence but also the exact location and size of the fistula. A ureteral stent can be placed in the fistula during the cystoscopy to confirm the connection between the bladder and the vagina in case of any doubt [6]. The diagnostic evaluation of VVFs can include a contrast CT or MRI, which can also evaluate the upper urinary tract or show the presence of combined fistulas [7]. Alternatively, we can also opt for a voiding cystourethrogram to confirm the presence of VVF [1]. There are many possible approaches for the treatment of VVFs. This condition can for example be managed conservatively with 2 to 6 weeks of urinary catheterization combined with anticholinergic medication if the VVFs are small enough [8,9,1]. Alternatively, or when the conservative treatment fails, we can choose between several surgical approaches mainly categorized into vaginal and abdominal techniques [10]. The open abdominal techniques are associated with greater blood loss, greater morbidity, and longer recovery compared to the vaginal approach, but they can be more suitable if there is a need for ureteral reimplantation or if the VVFs are high in the vaginal canal. The choice of treatment should be determined for each patient individually based on the anatomy of the fistula and the experience of individual surgeons [10,4,1]. In a perspective of a future when the role of minimally invasive surgery will be more important, we are presenting a case of VVF repaired with a robot-assisted technique using the DaVinci Xi® Surgical System (Intuitive Surgical, USA) in the University Medical Centre Ljubljana.

CASE REPORT

A female patient in her late thirties came into our office complaining of constant urinary leakage from the vagina. This symptom presented 3 months after Wertheim - Meigs surgical treatment for cervical cancer performed through a Pfannenstiel incision. After the surgical procedure, she had an indwelling catheter placed to partially relieve the incontinence. An in-office cystoscopy was performed which clearly identified the fistula behind the interureteric bar, slightly towards the left ureteric orifice. The diameter of the fistula was less than 1 cm (Figure 1).

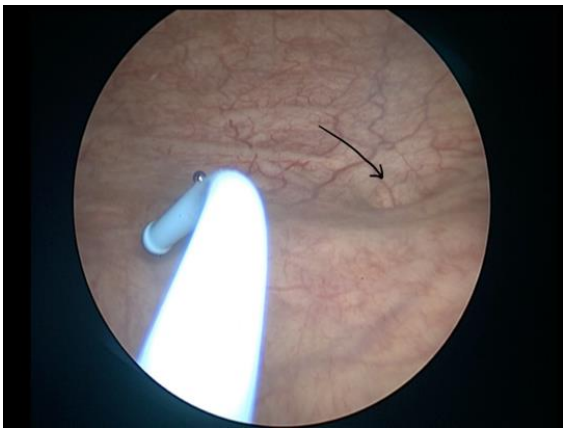

Figure 1. Cystoscopy; the arrow indicates the vesicovaginal fistula.

Drainage of liquid from the bladder into the vagina was observed during cystoscopy. This phenomenon confirmed the presence of a VVF. An intravenous urography was performed after cystoscopy for the assessment of the upper urinary tract and to rule out the presence of a combined ureterovaginal fistula. After the diagnosis was confirmed, we opted for a robot-assisted laparoscopic fistula repair because the fistula was high and near the left ureter. The patient underwent the standard preoperative workup and preparation. The procedure was performed in general anesthesia in a lithotomy position with access to the vagina in the sterile operative field. Preoperative antibiotic prophylaxis was given. After the preparation of the operative field, cystoscopy was performed with identification of the ureteral orifices, and ureteral stents were inserted bilaterally to achieve better visualization of both ureters during the procedure. In this way, we minimized the chance of ureteral damage.

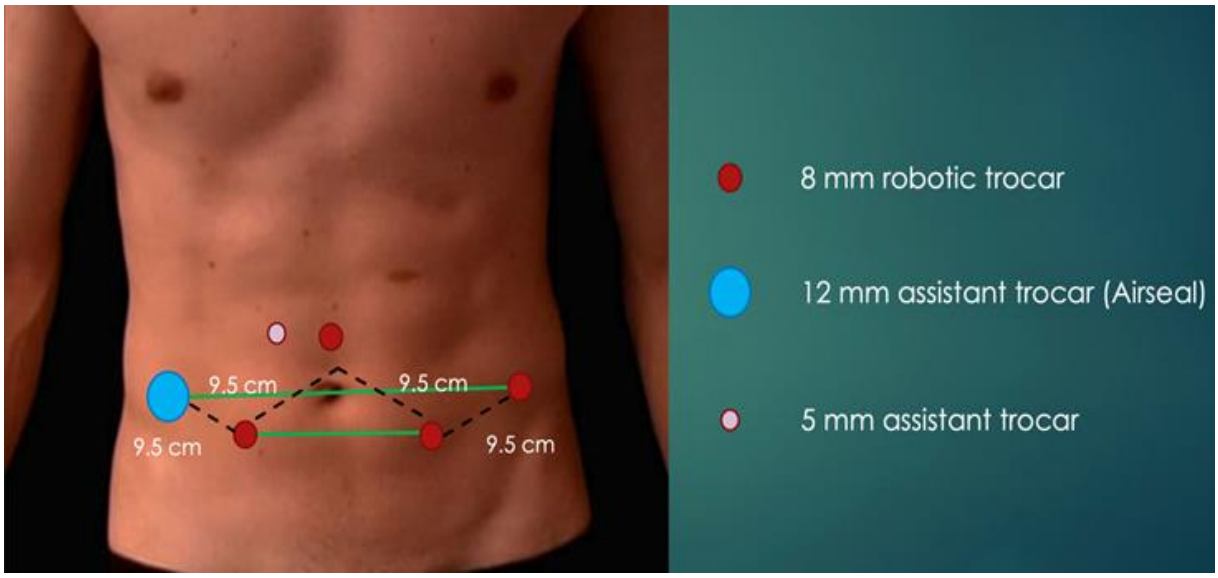

Figure 2. Port positioning

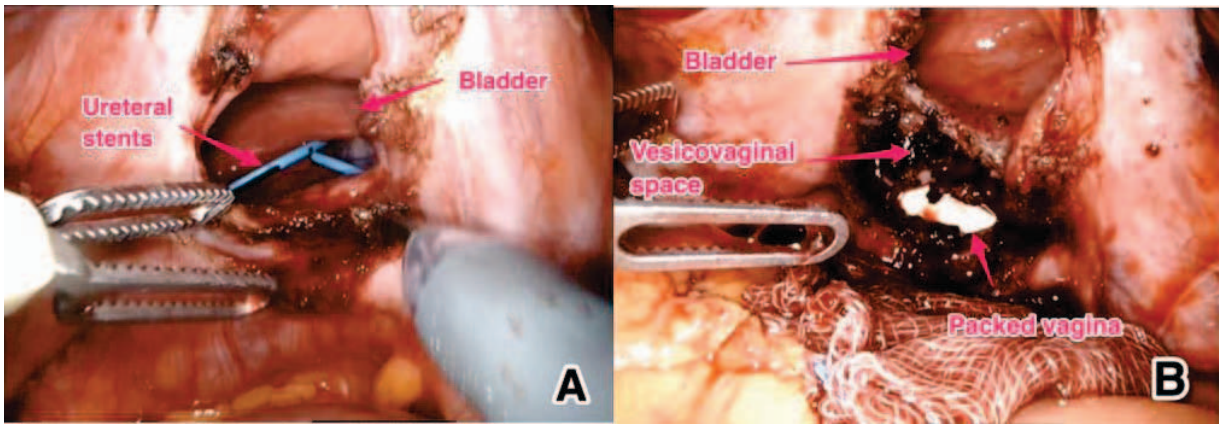

Figure 3. A) Opening in the bladder where ureteral stents were visualized; B) Intraoperative topographic anatomy of the bladder and vagina.

The next step was a transabdominal robot-assisted laparoscopic VVF repair. A pneumoperitoneum was performed using a Veress needle. Six ports were placed in a typical manner for the robot-assisted laparoscopic procedures in the pelvis (Figure 2).

We packed the vagina with gauze for better exposure. Consequently- we docked the DaVinci's robotic arms and visualized the bladder and the vagina using a transperitoneal approach. We continued with a blunt and sharp dissection of the layer between these two structures using bipolar fenestrated forceps and monopolar scissors and vertically incised the bladder wall down to the level of the VVF, and the fistula's tract was excised. Then we continued the dissection of the vesicovaginal space caudally to gain good exposure and the possibility to suture both layers in a tension-free manner (Figure 3A, B).

During the procedure, we were always aware of the position of the ureters which remained intact. After the excision of the fistula and the mobilization of the bladder, we closed the vaginal wall. Then we also mobilized the greater omentum and secured it with sutures into the vesicovaginal space. We used the omentum as an interpositional flap which reduced the possibility of recurrence (Figure 5).

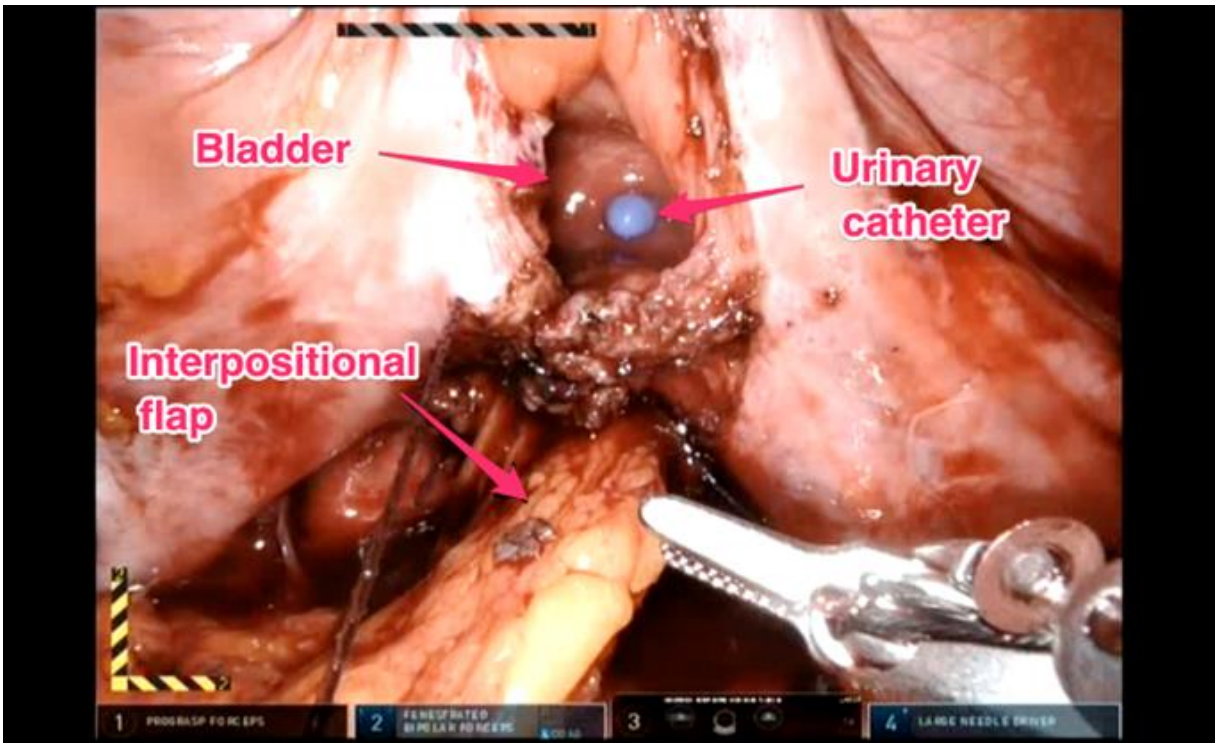

Figure 4. Interpositional flap with the greater omentum.

In the end, the bladder wall was sutured in two layers. The ureteral stents were previously extracted intraoperatively. The indwelling catheter was placed in the bladder, and a negative leakage test confirmed no sign of VVF.

Postoperative recovery was uneventful and the patient was discharged on day 2 with a Foley urinary catheter. The catheter was removed 4 weeks after the operation. A cystography was performed before the extraction of the catheter to exclude any extravasation of fluid from the bladder. The patient has had no sign of any drainage from the vagina ever since the procedure.

The robot-assisted laparoscopic vesicovaginal fistula repair was successful and the patient was relieved from the bothersome urinary incontinence achieving a better quality of life.

DISCUSSION

As mentioned in the introduction, there are many ways and approaches to treat vesicovaginal fistula. Each approach has its pros and cons. Decisions must be made on a case-by-case basis, taking into account the variable nature of the vesicovaginal fistula and the expertise of the surgeon. In this article, we reported a case of VVF which was successfully repaired with a transabdominal robot-assisted laparoscopic technique. Using this approach, we achieved a complete repair of the fistula with minimal blood loss, good cosmetic result, and fast recovery of the patient. We believe that minimally invasive surgery is going to have an even greater impact in the field of reconstructive surgery and that the robot-assisted laparoscopic method can represent an excellent choice of treatment of VVF in the hands of an expert surgeon.

STATEMENTS AND DECLARATIONS

Competing Interests: Not applicable.

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Informed Consent Statement: Informed consent was obtained from all subjects involved in the study. Written informed consent has been obtained from the patient(s) to publish this paper.

Ethics approval: The study was approved by the local ethnics committee.

Conflicts of Interest: None declared.

Consent for publication: Not applicable.

REFERENCES

1. De Ridder DJMKD, Greenwell T. Urinary tract fistulae. In: Partin WA, Dmochowski RR, Kavoussi RL, Peters CA, eds. Campbell-Walsh-Wein Urology. Twelfth edition. Philadelphia: Elsevier; 2020.

2. Kumar S, Kekre NS, Gopalakrishnan G. Vesicovaginal fistula: an update. Indian Jurol 2007; 23(2): 187-191.

3. Schwartz DA. Archeological basis for obstetrical fistula: a condition that is as ancient as humans themselves. In: Drew LB, Ryder B, Schwartz DA, eds. A multidisciplinary approach to obstetric fistula in Africa. Global maternal and child health. https://doi.org/10.1007/978-3-031-06314-5_3: Springer, cham; 2022

4. Harding CK, Lapitan MC, Arlandis S, et al. EAU guidelines on management of non-neurogenic female lower urinary tract symptoms (LUTS). Arnhem: EAU Giudelines Office; 2021.

5. Bacalbașa N, Lintoju B, Bălescu I,et al.. Diagnostic and management in vesicovaginal fistulas. Journal of translational medicine and research; 2016 Jan; 21 (2): 95

6. Stamatakos M, Sargedi C, Stasinou T, et al. Vesicovaginal fistula: Diagnosis and management. Indian J Surg; 2014 Apr; 76(2): 131-136.

7. Randazzo M, Lengauer L, Rochat CH, et al. Best practices in robotic-assisted repair of vesicovaginal fistula: a consensus report from the European association of urology robotic urology section scientific working group for reconstructive urology. European urology 2020; 78: 432-442.

8. Shanmugham D, Kondra S, Vasudevan S. Conservative management of vesicovaginal fistula: a rare case report. International journal of reproduction, contraception, obstetrics and gynecology; 2016 May; 5 (5): 1643-1645.

9. Davits RJAM, Miranda SI. Conservative treatment of vesicovaginal fistulas by bladder drainage alone. British journal of urology; 1991 Aug; 68: 155-156.

10. Hillary CJ, Chapple CR. The choice of surgical approach in the treatment of vesico-vaginal fistulae. Asian journal of urology; 2018 July; 5: 155-159.

Surgery and Surgical Endoscopy

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Original Article

Management of giant incisional hernia: Case report

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Key Words: Hernia; incisional; loss of domain; TAR

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Abstract

Abdominal incisional hernias are a common problem and a well-known complication after abdominal surgery. Their occurrence depends on factors such as sex, age, obesity, abdominal distension, bowel surgery, suture type, and infections of the chest or wound. Many methods have been tried and developed to repair hernia defects. The success of the abdominal wall reconstruction correlates with the size of the hernia. The larger the hernia, the less chance of success. Loss of domain is defined as a clinical situation when more of the viscera is outside the abdominal cavity than inside.

The aim of this article is to report a case of ventral loss of domain hernia in a 73-year-old man and its successful treatment with a procedure called transversus abdominis muscle release.

One approach to returning the viscera to the abdominal cavity is component separation, or release of the abdominal wall musculature, which can provide additional space to do so. The transversus abdominis muscle release (TAR) procedure is a new myofascial release technique for repairing complex ventral hernias. TAR is a type of posterior component separation associated with low perioperative morbidity, as well as a low recurrence rate.

INTRODUCTION

Ventral hernias can occur near a prior surgical incision site and are often caused by poor wound healing or tissue healing failure. Incisional hernias are one of the most common complications after

abdominal surgery and may occur after 10 – 20% of midline laparotomies [1]. The occurrence of ventral hernias is on the rise due to more patients being elderly, obese, and diabetic, and other factors such as poor nutrition, surgical site infection, and increased intra-abdominal pressure [2]. The European Hernia Society (EHS) classifies incisional hernia according to size. Hernias with a length or width less than 5 cm are considered small, hernias that are 5-10 cm are considered medium, and hernias over 10 cm are considered large [3]. When a significant amount (50% or more) of the visceral contents are in the hernia sac, the term loss of domain is used. These classifications and terms are used to predict operative difficulty and success [4].

The introduction of synthetic and biological mesh throughout the past 40 years has lowered the recurrences of complex ventral incisional hernias to 8 – 24%, meaning general and plastic surgeons see them sporadically [3]. Complexity is defined by the criteria proposed by Slater et al. These criteria consider variables in size and location, contamination, soft tissue condition, patient history, risk factors, and the clinical scenario [5].

Ventral hernia repair is one of the more challenging surgical operations. Of the many techniques (onlay, inlay, sublay, and underlay) for mesh repair, it is suggested that sublay has the lowest recurrence and surgical site infection rate in open anterior abdominal hernia repairs [6].

We present a successful single-time treatment of per magna incisional hernia (loss of domain) with wound infection.

CASE PRESENTATION

A 73 years old male patient presented to the Department of General Surgery of the General Hospital Slovenj Gradec with a massive ventral incisional hernia. In the past, 4 surgical procedures which include his abdominal wall were made. The last was in April of 2008. The patient was unable to do regular activities, his comfort was at a minimum, and he complained about the abdominal hernia band that he had to use to prevent hernia expansion.

On examination, there was a scar in the midline from the upper abdomen down to the suprapubic region. In the lower part of the abdomen, there was a large defect in the abdominal wall. The patient had a 30x20 cm lump protruding through the defect so there was no doubt the intestine was inside.

A CT scan confirmed ventral hernia per magna in the abdominal wall without signs of incarceration, the hernial neck was approximately 95 mm wide, and the hernial sac was filled with plenty of peritoneal fat, intestinal loops, colon ascendens and transversum. There was either a supraumbilical diastasis recti in width of 40 mm and a small umbilical hernia filled with peritoneal fat (Figure 1).

The patient was evaluated for possible surgical correction. The patient has surgical risk factors such as high blood pressure, hyperlipidemia, CKD 3B, diabetes mellitus on insulin, and coronary artery disease with LAD in-stent. Adequate preoperative anesthesia evaluation was carried out due to the absence of indications for emergency surgery. Routine laboratory blood investigations were normal. Six weeks before the surgical procedure, the application of botulinum toxin A in the abdominal wall was made. In October 2021 the patient underwent open incisional hernia repair and was preoperatively given an antibiotic and an indwelling Foley catheter for indirect measurement of abdominal pressure was inserted. With a midline approach, the skin and subcutaneous flaps were raised, and hernial sacs were identified. Laparotomy was performed to connect the smaller umbilical hernia and large ventral hernia. The adhesions between organs were lysed followed by

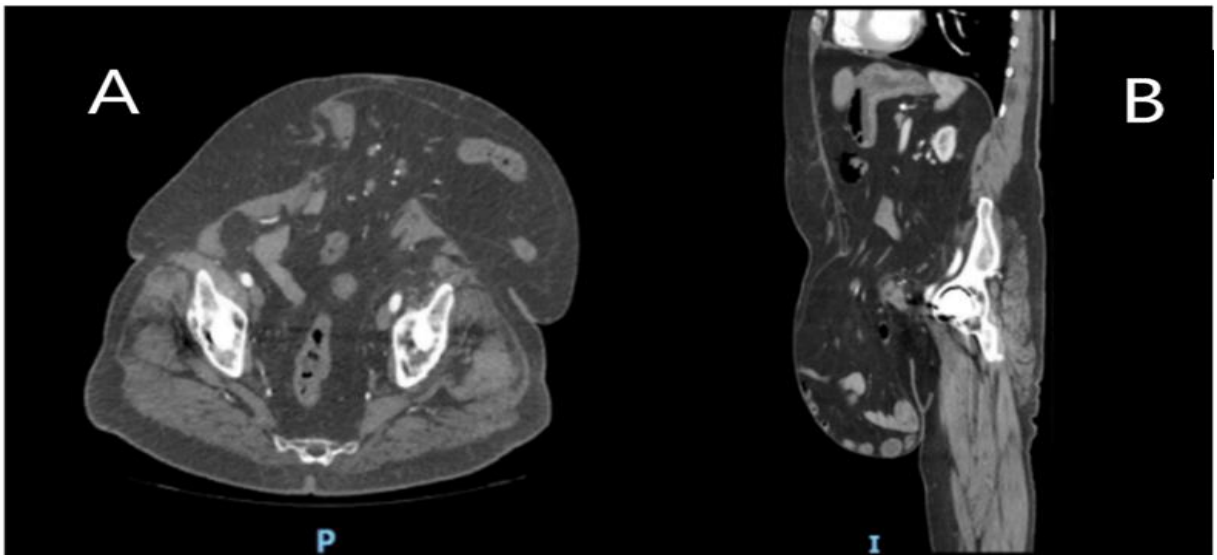

Figure 1. Contrast-enhanced CT of the abdomen. A-transverse view, B-sagittal view

a complete omentectomy. The hernial sac was dissected to the fascial border of the hernial ring and mobilized. Then the transversus abdominis

release (TAR) was made from the midline to both lateral edges. The posterior rectus sheath was approximated without tension. Intra-abdominal pressure stayed the same. Large polypropylene mesh in size of 35x30cm was placed and transfascial suture mesh fixed. The anterior fascia was closed. Closed suction drains were placed followed by removing the excess skin and fat and closure of the dermis and skin.

Postoperatively the patient was followed up in the intensive care unit and discharged to the regular unit the next day where he was stable and without complications. In the following days, demarcation in the distal part of the wound was observed. The VAC (vacuum-assisted closure) system was placed and antibiotics were given. Gradually, the wound was closed. The patient was discharged and showed no recurrence or complication during a follow up period of 5 months.

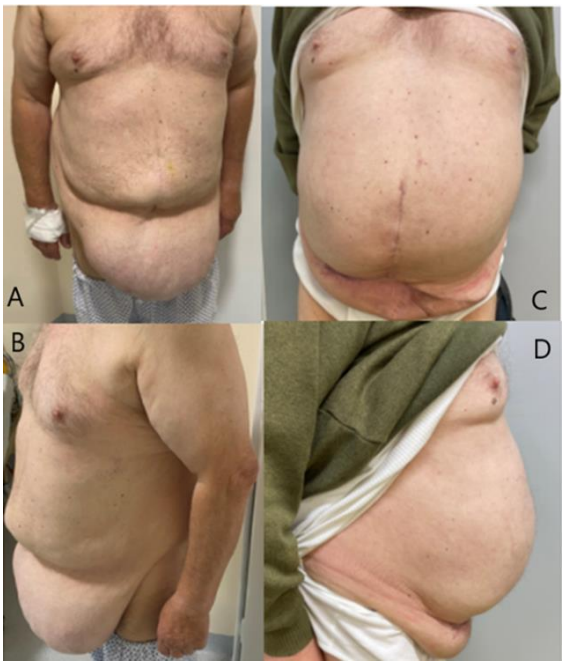

Figure 2. A, B-preoperative photographs, C, D-late post-op photographs

DISCUSSION

When there is a hole in the abdominal wall muscles that allows a loop of intestine or abdominal tissue to push through the muscle layer, a hernia has occurred. This can happen at any location along the midline of the abdominal wall [1].

The EHS System that classifies ventral hernias subdivides them into primary and incisional types. Primary hernias are not associated with previous surgery, and are subdivided into midline and lateral, with two variables: width and length. Incisional hernia subtypes are more sophisticated than primary ones. They can occur anywhere in the abdominal wall and are documented in terms of length and width. They are the most common complication after abdominal surgery, developing in up to 20% of postoperative patients, with a recurrence rate of 20-46% [6].

The term loss of domain is used when a significant amount (>=50%) of the abdominal contents are in the hernia sac, expressing the relationship between hernia and abdominal volume. The term is used to predict operative difficulty and success.

European and American ventral hernia working groups have recommended preoperative optimization and lifestyle measures. These measures are related to smoking cessation (>4 weeks before surgery), maintaining blood glucose (HbA1c below 7%) in diabetic patients, and weight-loss regimens (to attain BMI below 30kg/m^2) [5].

We presented a clinical case of a ventral incisional hernia, loss of domain, repaired with transversus abdominis release (TAR) technique.

Novitsky introduced the transversus abdominis release (TAR) technique in 2012, showing durable results with this new reconstructive technique. TAR is a modification of the Rives-Stoppa technique [7]. The TAR technique allows for the placement of a large prosthesis in the retro-muscular plane with considerable myofascial medialization [8]. This technique is associated with low perioperative morbidity and low recurrence rates [7].

Punjani et al. carried out a retrospective study in which 100 consecutive patients, who underwent open TAR with prosthetic mesh repair, were identified. Eighty-eight of them had incisional hernias. The patients' mean defect was 140.18 cm^2. The results of this study showed a mere 3% readmission rate and zero recurrences at a mean follow-up duration of 20.2 months [8].

Hernia surgery has been revolutionized by the development of synthetic mesh; it has significantly improved recurrence rates and patient satisfaction. Ventral wall reinforcement with onlay, inlay, and sublay meshes in open repairs have varied results. In 2008, a Cochrane review comparing sublay and onlay mesh positions found no significant difference in recurrence rate but did find the mean operative time to be shorter in the sublay cases. Contrarily, in 2014 (Timmermans L et al.), a meta-analysis comparing them found sublay to have a slightly better recurrence and surgical site infection rates [10].

Application of BTA in the abdominal wall was made before the operation. The procedure has been known in our institution for a few years. Golobinek published an article on the indications and risks of botulinum toxin A (BTA) usage. The preoperative application of BTA causes flaccid paralysis of the lateral abdominal muscles and their relaxation, resulting in lower wound tension when closing the abdominal wall. This method has been proven effective and safe [11].

Negative pressure wound therapy can be applied to subcutaneous tissue where an infection has occurred. The Vacuum Assisted Closure (VAC) system reduces tension at the healing incision. It can promote angiogenesis, granulation, and tissue perfusion and reduce the risk of infection.

No well-designed RCTs have proven one mesh type superior to another, nor have they shown clear advantages of a particular surgical approach; therefore, the choice of mesh and surgical technique, particularly in contaminated or infected operative fields, remains controversial [5].

Surgeons with expertise in complex abdominal wall hernias reached a consensus on 22 patients for criteria used to define a patient with a complex hernia. Common criteria used for defining and describing complex hernia patients are identified and divided into four categories: size and location, contamination/soft tissue condition, patient history/risk factors, clinical scenarios, and three classes of severity: minor, moderate, and major [12].

The contents of most ventral hernias include small intestine, colon, fat or fibrous tissue. The most serious complication is impaired intestinal blood supply, often leading to intestinal incarceration and necrosis [2].

Clinical presentations of ventral hernias can be classified as uncomplicated or complicated. Uncomplicated hernias present as a swelling through the abdominal wall; they can be reduced or partly reduced with a preserved impulse cough. Complicated hernias present with inflammation, incarceration, obstruction, strangulation, or perforation of the abdominal content [6].

Our case was diagnosed by a CT scan. A CT scan is recommended for hernia diagnosis, as it shows the content of the hernia and helps with the choice of the treatment strategy. The CT scan can be used by surgeons to evaluate and determine the safest and most desirable mesh placement method. An enhanced abdominal CT scan can show the relationship between abdominal contents and defects, particularly for obese patients and patients with recurrent ventral hernias [2].

The development of a giant ventral hernia will have a negative impact on the patient, both physiologically and psychologically. They will be in pain and unable to carry out daily activities. They may have disturbances in their moods, sleep, relationships, and general displeasure with life, which leads to poor quality of life. In many patients, although the hernia has been successfully repaired, the skin of the abdominal wall may not heal as fast after surgery, causing the patient to feel dissatisfied and a decline in their sense of self-worth. Given time the patient should lose almost every negative effect of the hernia [2].

During treatment in the presented case, a large lump was removed. By the second follow up, the patient lost almost every negative effect and he was pleased and thankful that we were able to provide him with a better life.

STATEMENTS AND DECLARATIONS

Competing Interests: Not applicable.

Funding: Not applicable.

Acknowledgments: Not applicable.

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study. Written informed consent has been obtained from the patient(s) to publish this paper.

Ethics approval: The study was approved by the local ethnics committee.

Conflicts of Interest: None declared.

Consent for publication: Not applicable.

REFERENCES

1. De Oliveira Leite TF, Sarmento Pires LA, Araujo Chagas CA. Ventral incisional hernia case report: A therapeutic challenge. SAGE Open Medical Case Reports. Volume 8: 1–4. doi:10.1177/2050313X20927624

2. Luo X, Lu C, Wang W, et al. Giant ventral hernia simultaneously containing the spleen, a portion of the pancreas and the left hepatic lobe: A case report. World J Clin Cases. 2020 May 6; 8(9): 1721–1728. doi: 10.12998/wjcc. v8. i9.1721

3.Assenza M, Reali C, Marenga G, et al. Treatment of permagna incisional hernia with skin necrosis

and abscess: case report. Clin Ter 2014; 165 (2):e158-161. doi: 10.7471/CT.2014.1701

4. Parker SG, Halligan S, Blackburn S et al. What Exactly is Meant by "Loss of Domain" for Ventral Hernia? Systematic Review of Definitions. World J Surg. 2019; 43(2): 396–404. doi: 10.1007/s00268-018-4783-7

5. Knaapen L, Buyne O, Slater N, et al. Management of complex ventral hernias: results of an international survey. BJS Open. 2021 Jan; 5(1): zraa057. doi: 10.1093/bjsopen/zraa057

6. Issa M, Noureldin K, Elgadi A, et al. Evaluation of the Sublay Mesh Repair Outcomes in Different Types of Ventral Hernia. Cureus. 2021 Dec; 13(12): e20590. doi: 10.7759/cureus.20590

7. Siegal SR, Pauli EM. Posterior component separation/transversus abdominis release. Plast Aesthet Res 2019; 6:25. doi: 10.20517/2347-9264.2019.35

8. Punjani R, Arora E, Mankeshwar R, et al. An early experience with transversus abdominis release for complex ventral hernias: a retrospective review of 100 cases. Hernia. 2021 Apr;25(2):353-364. doi: 10.1007/s10029-020-02202-w

9. Timmermans L, De Goede G, Van Dijk SM, et al. Meta-analysis of sublay versus onlay mesh repair in incisional hernia surgery. Am J Surg. 2014 Jun;207(6):980-8. doi: 10.1016/j.amjsurg.2013.08.030

10. Scott S, Khanna A, Finch J. An unusual presentation of an incisional ventral wall hernia: A case report. International Journal of Case Reports and Images. January 2015; 6(9):570. doi: 10.5348/ijcri-201592-CR-10553

11. Vertačnik JG, Kunst G, Leskiewicz PM. Preoperative Application of Botulinum Toxin A in Operative Treatment of Ventral Hernia: Case Reports from Slovenj Gradec General Hospital. Surgery Surg Endos 2021; 3(2): 91-96

12. N J Slater, A Montgomery, F Berrevoet, A M Carbonell, A Chang, M Franklin et al. Criteria for definition of a complex abdominal wall hernia. Hernia. 2014 Feb;18(1):7-17. doi: 10.1007/s10029-013-1168-6

Surgery and Surgical Endoscopy

December 2022

Original Article

Is trapeziectomy alone enough for a good outcome in treatment of thumb carpometacarpal osteoarthritis? A review of the literature.

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Key Words: thumb carpometacarpal joint; osteoarthritis; surgery; trapeziectomy

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Article info

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Abstract

Thumb carpometacarpal joint osteoarthritis is the second most common osteoarthritis in the hand. It mostly affects postmenopausal women. The diagnosis is made based on clinical examination. Primary treatment is conservative and if it is unsuccessful surgical. There are many surgical procedures available, with the aim to restore thumb function and a pain-free, stable, and mobile joint. A review of the English literature comparing trapeziectomy alone with other procedures showed no differences regarding pain, range of motion, and physical function. Nevertheless, trapeziectomy alone had fewer complications in treating later stages.

INTRODUCTION

Thumb carpometacarpal (CMC) joint osteoarthritis (OA) is a common and frequently debilitating condition [1, 2]. It is the second most common site of osteoarthritis in the hand [3, 4], with a prevalence of up to 36% in postmenopausal women [1, 2, 4, 5]. Susceptibility towards OA of the thumb in women is attributable to anatomic (a smaller, less congruous shallow saddle joint, flat trapezial facet), hereditary (dysplastic joint), and hormonal factors (increased ligament laxity) [3]. Trauma such as Rolando or Bennett fractures, repetitive trauma in work-related mechanical loading (lead to synovitis and cartilage loss), history of inflammation, obesity, and metabolic defects are also risk factors for developing OA of the thumb CMC joint [1, 3].

The thumb CMC joint or the basal joint is a biconcave-convex saddle joint [1, 3, 4]. It consists of four articulations: the trapeziometacarpal (TM), trapeziotrapezoid (TT), schapotrapezial (ST) and trapezium-index metacarpal (TIM) [1, 4]. Capsular ligaments of the basal joint, i.e. the anterior oblique ligament, the posterior oblique ligament, the dorsoradial ligament, the intermetacarpal ligament, and the ulnar collateral ligament [1, 4], are the most important joint stabilizers [1, 3, 4]. Cadaveric studies of Pellegrini et al. identified that the key factor in developing OA of the basal joint was the mechanism of ligament laxity [3, 4]. The anterior oblique ligament is the key restraint to dorsoradial subluxation [1, 3, 4].

The clinical presentation of the basal joint OA is localized pain, swelling, instability, weakness with dropping objects and loss of pinch strength, limited range of motion, and joint deformities [1, 2, 3, 4, 6]. With the progression of the disease, the basal joint becomes stiff and adducted, leading to subluxation [1]. In patients with thumb CMC joint OA, as a result of synovial thickening, we also often encounter Carpal tunnel syndrome, De Quervain's tenosynovitis, and Trigger finger [1, 3, 4].

The diagnosis is made based on clinical examination and is confirmed with radiography [3, 4]. The disease stage can be set by a radiographic classification system made by Eaton and Glickel [3, 4, 7] and is divided into four stages [3, 4].

Primary treatment of the thumb CMC joint OA is conservative [1, 2, 3, 4, 8, 9] and aims at restoring the thumb function with a pain-free, stable and mobile joint [9]. This includes rest, splinting, anti-inflammatory drugs, joint steroid injections, physiotherapy, and patient education [1, 3, 4, 8]. Surgery is required after a 3-month trial without improvement [3, 4]. The available surgical treatments are: volar ligament reconstruction, metacarpal osteotomy, CMC arthrodesis, partial or complete trapeziectomy, trapeziectomy with tendon interposition (TI), trapeziectomy with ligament reconstruction (LR), trapeziectomy with ligament reconstruction and tendon interposition (LRTI), implant arthroplasty [1, 3, 4, 6, 10, 11] and thumb CMC joint denervation [9, 12, 13].

The purpose of this article is to present the possible surgical treatment options for the thumb CMC joint OA and see if trapeziectomy alone is sufficient for a good outcome in treating such a condition. We performed electronic searches in PubMed and Ovid databases based on the treatment of thumb CMC joint OA. We included review articles and research articles. We used only English literature.

SURGICAL TREATMENT OPTIONS

VOLAR LIGAMENT RECONSTRUCTION

This kind of treatment is ideal for patients presenting with early stages of OA [1, 4, 6]. Some say the procedure is only affected in Eaton and Glickel stage I (4), while others also use it for stage II [1, 6]. The plan is to reconstruct the anterior oblique ligament or the beak ligament using 50% of the width of the FCR tendon [1, 4, 6]. Long-term results show that 65% of patients exhibited no radiographic progression of the disease at a 15-year follow-up [1].

METACARPAL EXTENSION OSTEOTOMY

Appeasement of the anterior oblique ligament first leads to cartilage breakdown volary [4]. Wedge metacarpal base osteotomy at the dorsoradial aspect of the thumb [1, 4, 6], followed by transfixing the wedge defect by two Kirschner (K) wires [1], was first described by Wilson in 1973 [4, 6]. With this procedure we shift the mechanical stress forces from the injured volar surface to preserved dorsal surface [1, 4]. The procedure is used only with focal cartilage damage in Eaton and Glickel stages I and II [1, 4, 6], as was concluded by Atroshi et al. [6].

CMC JOINT ARTHRODESIS

CMC joint arthrodesis was first performed by Muller in 1949 and became quite a popular procedure [6]. Indications for such a procedure are CMC joint OA stage II and III, without any ST joint impairment, and young active patients that require a strong grip and pinch. The procedure involves fusing the thumb joint in 20° of radial and 40° of palmar abduction, using K-wires, cerclage wires, tension bend wires or plates, and screws [1, 4]. Despite comparable nonunion rates (between 8% and 21%) in using K-wires or plates, the latter has a lower satisfaction rate, as showed by Foresth et al. [6]. Arthrodesis is a technically demanding procedure that requires quite a long period of immobilization. Despite limited mobility, minimal functional deficit has been reported [4].

COMPLETE TRAPEZIECTOMY

Trapeziectomy is one of the first procedures for CMC joint OA described by Gervis in 1949 [4, 6]. The procedure involves the excision of the entire trapezium [1, 14, 15] and is typically performed in symptomatic patients with Eaton and Glickel stage II – IV [4]. The major complaint of this procedure was the shortening of the thumb, instability, and the possibility of subluxation [2, 14, 15]. Because of this, a number of variations have been described to preserve thumb length, prevent instability, and provide better thumb strength [2, 15, 16]. Variations are trapeziectomy with hematoma and distraction arthroplasty (HDA), trapeziectomy with interposition, trapeziectomy with ligament reconstruction or ligament reconstruction and interposition, and partial trapeziectomy with interposition [2, 4, 14].

HEMATOMA AND DISTRACTION ARTHROPLASTY (HAD)

HAD consists of a complete excision of the trapezium and temporary fixation with a K-wire for stabilization and distraction of the thumb metacarpal. Fixation is done from the thumb metacarpal base to the base of the second metacarpal or trapezoid. The thumb is immobilized in a short-arm spica cast for 10 days and K-wires are removed after 3-6 weeks. Kuhs et al. reported that patients following HAD had equal, if not superior strength and motion compared to more complicated procedures in similar intervals. A similar conclusion was made by Gray et al. (14).

TRAPEZIECTOMY WITH INTERPOSITION OR SUSPENSIOPLASTY

De Smet et al. concluded in their study that there is a significant correlation between the key pinch strength and trapezial space [2]. To preserve scaphometacarpal space and prevent proximal migration of the first metacarpal into the void, some authors suggest using interposition or suspensioplasty [17, 18, 19]. Interposition can be done with autograft (flexor carpi radialis (FCR) tendon, palmaris longus tendon) or allograft tendon (meniscal allograft, fascia lata), gore-tex, marlex, Permacol, Artelon spacer, Swanson silicone implant, pyrocarbon implant, Dacron or Arex [2, 7]. Suspensioplasty is usually done using the abductor pollicis longus (APL) tendon [18, 19, 20] or FCR tendon [5, 17, 21] and suture button or TightRope suspensioplasty [8, 11].

In suspensioplasty with APL, APL is harvested at the musculotendinous junction and usually looped around the FCR tendon and sutured to itself [18, 19, 20]. APL can also interweave with the extensor carpi radialis brevis (ECRB) tendon, extensor carpi radialis longus (ECRL) tendon, and FCR tendon. Some also use bone tunnels and K-wire fixation (18). For a suspensory ligament reconstruction, half or the entire FCR tendon is used [21]. Satteson et al. found no significant differences in pain, range of motion or radiograph subsidence between the two techniques. On the contrary, APL suspensioplasty offers shorter operative time, shorter postoperative immobilization, and avoidance of additional incisions, bone tunnels, and K-wires [18].

Suspensioplasty can also be performed using TightRope, which is passed through bone tunnels between the first and second metacarpal and secure on both sides [8, 11]. It is a type of HAD, in which we do not need to use K-wires. This enables immediate thumb range of motion (ROM) [8], allowing patients to return to function quicker [11]. The main complication of this procedure, as reported by Yao et al., is the possibility of a second metacarpal fracture [8].

Recently, there has been a lot of donor site morbidity mentioned in the literature regarding interposition with autograft [21]. Consequently, surgeons began to use synthetic materials and allografts [2, 21]. The problem with synthetic materials, especially silicone implants, is that they carry high rates of synovitis, foreign body reactions, and mechanical failure [7, 21]. Because of these limitations, allograft procedures were developed [2, 7, 21]. Shapiro et al. recommend using meniscal allograft, which is placed over the dorsal aspect of the trapeziometacarpal space and fixed with suture anchors. His results were comparable to other surgical techniques, regarding pain, outcome, strength, motion, operative time, and return to work, with fewer complications such as foreign body reactions and synovitis [7]. Same results were seen in fascia lata interposition done by Spaans et al. Despite donor site morbidity, Vermeulen et al. concluded that it is better to perform interposition with autologous tissue than allografts [2].

COMPLETE TRAPEZIECTOMY WITH LIGAMENT RECONSTRUCTION AND TENDON INTERPOSITION (LRTI)

LRTI is a procedure first described by Burton et al. in 1986 [6, 10, 15]. The procedure is basically suspensioplasty with placing the rest of the tendon in the trapezium void [18]. Half or the entire FCR tendon is the most commonly used autograft. It was previously reported that using the entire FCR tendon does not impair function. Latter Naidu et al. found that the unaffected hand had 2.5 times greater wrist flexion fatigue resistance and that the surgical side had lower wrist flexion-extension peak torque ratio [21]. In LRTI a bone tunnel is drilled in the base of the first metacarpal. FCR tendon is then transacted cranially and split. Half of the tendon is passed through the hole and tied to each other. The rest of the tendon is placed in the trapezium void [18]. It is the most common practice technique among hand surgeons [22]. Kriegs-Au et al. compared LRTI with just suspensioplasty and found no differences in the outcome between those procedures [10, 21].

The main disadvantages, described in the literature, of using autografts are scar tenderness, tendon adhesion or rupture, hematoma, neuroma formation, and complex regional pain syndrome. To avoid such things, Kokkalis et al. recommend GraftJacket or acellular dermal allograft, which is produced from cadaveric tissue stripped of cellular components and preserved collagen scaffold. Acellular dermal allograft is passed around the FCR tendon and sutured to itself. The other end is then passed through a hole in the first metacarpal to the dorsal hole in a volar/dorsal direction and folded back on itself. Their study showed that it can be used safely and successfully [21].

PARTIAL TRAPEZIECTOMY

To avoid the possibility of impingement between the thumb metacarpal and the distal pole of scaphoid with loss of thumb length, as Wajon et al. stated, a partial trapeziectomy with interposition can be performed. It has the advantage of ligamentous stability maintained at ST joint. Compared to a complete trapeziectomy, in partial trapeziectomy the stability is better because most of the ligaments of the TM joint remain intact. It also provides long-lasting relief of symptoms. A contraindication for such a procedure is ST arthritis [2].

IMPLANT ARTHROPLASTY

There are 19 different total joint prostheses described in the literature [23]. Among them, Swanson endoprosthesis has the longest track record, with 26% implant subluxations or failures [10]. However, recent studies showed that total joint arthroplasty is a good option for treating OA stage II and III, with significantly better function in the joint in the early stages compared to other procedures [6, 24]. So far, the cost of implant arthroplasty is much higher with equal performance, which is why surgeons use it less often [23].

DENERVATION

A denervation technique has been found to avoid postoperative immobilization, possible weakness in pinch and grip strength and instability in treating thumb CMC joint OA [9, 12, 13]. Denervation can be done through the Wagner approach, single dorsoradial approach, double incision approach or single transverse volar approach [9]. Dorsoradial and dorsoulnar sensory branches from the radial nerve, the terminal branch of Curveilhier, and the nerve branches from the palmar cutaneous branch of the median nerve are separated and divided [12, 13]. Some surgeons also transact the thenar branch from the median nerve [13]. After transection, some authors make synovectomy, excision of osteophytes, joint irrigation, and double breasting of the capsule for stabilization [12]; others just irrigation with double breasting of the capsule [13]. Because the procedure does not restore joint integrity or stability, it is not fit for patients with disabling deformity or instability [9, 13].

DISCUSSION

A variety of surgical techniques exist for treating thumb CMC joint OA. Trapeziectomy remains the gold standard procedure [1, 9, 13]. In our review article, we wanted to present all the possible surgical treatments, with emphasis on trapeziectomy alone.

Salem in Davis showed that patients after trapeziectomy have reliable outcomes with good pain relief and movement in around 85%, but without measurable gain in strength [23]. DeSmet found no difference in pain score, grip, or pinch strength comparing trapeziectomy alone with LRTI [3]. Similar results were found by Brennan et al. [5]. Complications, such as sensory changes in superficial radial sensory nerve, scar tenderness, tendon adhesions, CRPS, and wound infections were much higher in LRTI [10, 16]. To reduce complications, LRTI can be done using meniscal allograft, as described by Shapiro et al. The result of such a procedure is comparable to other surgical techniques [7].

No procedure was significantly better than the other regarding pain, range of motion, and physical function, when comparing trapeziectomy with all other types of surgery. Denervation was excluded in the study [10].

Salibi et al. showed no significant difference in functional outcome, rehabilitation time, and cost-effectiveness between denervation and trapeziectomy alone [13]. But studies of Arenas-prat, Lorea, Giesen et al. and Salibi et al. comparing those two procedures excluded patients with severe thumb CMC joint deformities. It is sensible to assume that denervation is a less appropriate procedure in patients with OA stage IV [9].

Regarding complications, literature has shown that trapeziectomy alone had fewer complications. Metacarpal osteotomy, volar ligament reconstruction, and denervation were excluded [14]. It is safe to say that trapeziectomy alone is enough, if not even a preferred treatment option for later stages of thumb CMC joint OA.

CONCLUSION

Thumb CMC joint OA is a common condition, usually affecting postmenopausal women. The final treatment is always surgical. Comparing

trapeziectomy with all other surgical procedures, we can conclude that no procedure is superior to it, in terms of pain, range of motion, physical function, and strength. Regarding complications, trapeziectomy alone is superior to other procedures in treating later stages of thumb CMC joint OA.

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REFERENCES

1. Melville DM, Taljanovic MS, L Scalcione LR, et al. Imaging and management of thumb carpometacarpal joint osteoarthritis. Skeletal Radiol. 2014;44(2):165-77.

2. Spaans AJ, Weijns ME, Braakenburg A, et al. Partial trapezietcomy and interposition of fascia lata allograft in the operative treatment of thumb base osteoarthritis. J Plast Surg Hand Surg. 2016; 50(1):35-39.

3. Martou G, Veltri K, Thoma A. Surgical Treatment of Osteoarthrit is of the Carpometacarpal Joint of the Thumb: A Systematic Review. Plast Reconstr Surg. 2004; 114(2):421-432.

4. Batra S, Kanvidne R. Osteoarthritis of the thumb trapeziometacarpal joint. Current Orthopedics. 2007; 21:135-144.

5. Brennan A, Blackburn J, Thomson J, et al. Simple trapeziectomy versus trapeziectomy with flexor carpi radialis suspension: a 17-year follow-up of a randomized blind trial. J Hand Surg Eu Vol. 2021; 46:120-124.

6. Vermeulen GM, Slijper H, Feitz R, et al. Surgical Management of Primary Thumb Carpometacarpal Osteoarthritis: A Systematic Review. J Hand Surg Am. 2011; 36:157-169.

7. Shapiro PS, Diao E, Givens LM. Meniscal allograft arthroplasty for the treatment of trapeziometacarpal arthritis of the thumb. Hand. 2015; 10:407-416.

8. Yao J, Cheah AEJ. Mean 5-Year Follow-up for Suture Button Suspensionplasty in the Treatment of Thumb Carpometacarpal Joint Osteoarthritis. J Hand Surg Am. 2017; 42: 569.e1-569.e11.

9. Teo I, Riley N. Thumb carpometacarpal joint osteoarthritis: Is there a role for denervation? A systematic review. J Plast Reconstr Aesthet Surg. 2020; 73: 1208-1220.

10. Haase SC, Chung KC. An Evidence-Based Approach to Treating Thumb Carpometacarpal Joint Arthritis. Plast Reconstr Surg. 2011; 127: 918-925.

11. Mohan A, Shenouda M, Ismail H, et al. Patient functional outcomes with trapeziectomy alone versus trapeziectomy with TightRope. J Orthop. 2015; 12: 161-165.

12. Ehrl D, Erne HC, Broer PN, et al. Painful thumb carpometacarpal joint osteoarthritis: Results of a novel treatment approach. J Plast Reconstr Aesthet Surg. 2016; 69: 972-976.

13. Salibi A, Hilliam R, Burke FD, et al. Prospective clinical trial comparing trapezial denervation with

trapeziectomy for the surgical treatment of arthritis at the base of the thumb. J Surg Res. 2019; 238: 144-151.

14. Gray KV, Meals RA. Hematoma and Distraction Arthroplasty for Thumb Basal Joint Osteoarthritis: Minimum 6.5-Year Follow-Up Evaluation. J Hand Surg Am. 2007; 32: 23-29.

15. Davis TRC, Brady O, Dias JJ. Excision of the Trapezium for Osteoarthritis of the Trapeziometacarpal Joint: A Study of the Benefit of Ligament Reconstruction or Tendon Interposition. J Hand Surg Am. 2004; 29: 1069-1077.

16. Naram A, Lyons K, Rothkopf DM, et al. Increased Complications in Trapeziectomy with Ligament Reconstruction and Tendon Interposition Compared with Trapeziectomy Alone. Hand. 2016; 11: 78-82.

17. Barthel L, Diaz JJH, Vernet P, et al. Results of the treatment of frst carpometacarpal joint osteoarthritis: trapeziectomy alone versus trapeziectomy associated with suspensionplasty. Eur J Orthop Surg Traumatol. 2018; 28: 1555-1561.

18. Satteson ES, Driscoll C, Khan M, et al. Efficacy of Abductor Pollicis Longus Suspensionplasty Compared to Ligament Reconstruction and Tendon Interposition. Hand. 2022; 17: 85-91.

19. Sander AL, Buhrmann CF, Sommer K, et al. Simplifed abductor pollicis longus suspension interposition arthroplasty for thumb carpometacarpal joint osteoarthritis. Eur J Trauma Emerg Surg. 2022; 48: 1225-1230.

20. Sigfusson R, Lundborg G. Abductor Pollicis Longus Tendon Arthroplasty for Treatment of Arthrosis in the First Carpometacarpal Joint. Scand J Plast Reconstr Hand Surg. 1991; 25: 73-77.

21. Kokkalis ZT, Zanaros G, Weiser RW, et al. Trapezium Resection with Suspension and Interposition Arthroplasty Using Acellular Dermal Allograft for Thumb Carpometacarpal Arthritis. J Hand Surg Am. 2009; 34: 1029-1036.

22. Yuan F, Aliu O, Chung KC, et al. Evidence-Based Practice in the Surgical Treatment of Thumb Carpometacarpal Joint Arthritis. J Hand Surg Am. 2017; 42: 104-112.

23. Huang K, Hollevoet N, Giddins G. Thumb carpometacarpal joint total arthroplasty: a systematic review. J Hand Surg Eur Vol. 2015; 40: 338-350.

24. Thorkildsen RD, Røkkum M. Trapeziectomy with LRTI or joint replacement for CMC1 arthritis, a randomised controlled trial. J Plast Surg Hand Surg. 2019; 53: 361-369.

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Review article

Small Intestinal Bacterial Overgrowth after Bariatric Surgery - Literature Review

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Abstract

Introduction: Obesity is a global problem in developed countries and represents a medical challenge. The only effective treatment for sustained long-term weight loss is bariatric surgery. The surgical modification of normal gut anatomy may induce bacterial stasis and lead to small intestinal bacterial overgrowth (SIBO), a heterogeneous syndrome characterized by an increased number and/or abnormal type of bacteria in the small bowel. It may cause undesirable gastrointestinal symptoms, trigger other disease states, adversely affect metabolism and digestion, affect the incidence of gastrointestinal infections, and lower the quality of life after such procedures and surgical procedures due to other digestive tract pathology.

Objectives: Our goal was to investigate the prevalence of SIBO after bariatric surgery procedures, its influence on symptoms, and the urge to diagnose it after such procedures. Methods: Search in PubMed was performed using the following searching criteria: (SIBO bariatric surgery) and (SIBO bypass) and (SIBO and RYGBP) and (small bowel bacterial overgrowth and bariatric surgery) and (small bowel bacterial overgrowth and bypass) and (small bowel bariatric surgery and RYGBP). Results: 14 articles were found, and 11 met the inclusion criteria. The prevalence of SIBO ranges from 40% in asymptomatic patients to 83% in symptomatic patients after Roux-en-Y gastric bypass (RYGB) and 10% after adjustable gastric banding (AGB). There was no statistically significant difference in symptoms between the SIBO-positive and SIBO-negative groups. Conclusion: SIBO is common after bariatric surgery procedures, especially after RYGB, reaching up to 83% in symptomatic patients. Symptoms do not differ significantly from altered gut solely. Therefore, glucose breathing tests (GBT) are a helpful diagnostic tool for SIBO. Because of its prevalence, involvement in other disease states, exacerbation of other diseases, and influence on the quality of life, it is essential to diagnose SIBO after such procedures.

INTRODUCTION

The human body is an excellent medium that supports the growth of various microorganisms [1]. Microbiota is defined as the collective microbial community inhabiting a specific environment, including bacteria, archaea, viruses, and some unicellular eukaryotes [1]. The human microbiota is dominated by four phyla: *Actinobacteria*, *Firmicutes*, *Proteobacteria*, and *Bacteroidetes* [1]. These and other phyla's quantitative and qualitative composition varies between different body sites and among individuals. From the oral cavity to the anus, bacteria density increases in the jejunum/ileum and the large intestine compared to the stomach and duodenum [1].

Gut microbiota has three main roles in the host. The first role is metabolism, as gut microbiota affects energy harvest from the diet [1]. Colonic microbiota metabolizes indigestible polysaccharides to oligosaccharides and monosaccharides, fermented to short-chain fatty acids (SCFA). The evidence suggests that SCFA in normal conditions reduces appetite and/or alters the energy metabolism to promote a healthy body weight [1]. The second main role of gut microbiota is to protect the intestine against colonization by exogenous pathogens and microorganisms. It involves microbiota competition for limited nutrients and the modulation of immune responses. The third role is trophic, as butyrate, an SCFA with the most substantial effect, is the primary energy source for cells in the colon [1].

Disbalance of this complex intestinal microbiome, both qualitative and quantitative, might have serious health consequences for a macro-organism, including small intestinal bacterial overgrowth syndrome (SIBO) [2]. SIBO is a very heterogeneous syndrome characterized by an increased number and/or abnormal type of bacteria in the small bowel [2]. Most authors consider the diagnostic of SIBO to be the finding of ≥ 105 bacteria [i.e., colony-forming units (CFU)] per mL of proximal jejunal aspiration [2].

Several endogenous defense mechanisms prevent bacterial overgrowth, such as gastric acid secretion, intestinal motility, a properly functioning ileocecal valve, the production of secretory immunoglobulins, and the bacteriostatic properties of pancreatic juice and bile [2,3]. The etiology of SIBO is complex and is usually associated with disturbances to these defense mechanisms [3].

Symptoms of SIBO are nonspecific and include abdominal pain, belching, bloating, diarrhea, distension, flatulence, and indigestion that overlap and vary in frequency, duration, and severity. Typically, over two-thirds of patients report the symptoms [4].

The treatment of SIBO is based on the treatment of the causal diseases, the correction of the underlying anatomical particularities, the adaptation of the diet, and the qualitative and quantitative restoration of the intestinal microbiota after antibiotic treatment [5].

Obesity is a healthcare problem in developed countries and represents a medical challenge. SIBO is a frequent finding in obese patients, reaching 17–41% in obese patients, which is an increased prevalence compared to healthy subjects [6]. In these patients, SIBO was associated with severe steatosis, the first step before non-alcoholic steatohepatitis (NASH) [7]. Obesity etiopathogenesis is multifactorial, commonly involving hormonal, genetic, alimentary, and social factors. Alterations in the human microbiota have been hypothesized as factors predisposing to obesity [8]. Two phyla of bacteria, *Bacteroidetes* and *Firmicutes*, constitute more than 90% of the known dominant phylogenetic categories in the intestine [9]. The *Firmicutes phylum* includes more than 200 genera, many of which with better efficiency of calorie take–up than *Bacteroidetes* [9].

In obese people, there is a higher rate of *Firmicutes* in relation to *Bacteroidetes* [9]. The production of SCFA from nutrients that escape digestion in the small intestine could explain obesity, given the additional amount of energy [7].

The only effective treatment considered for sustained long–term weight loss is bariatric surgery, and the most effective procedure is Roux-en-Y gastric bypass (RYGBP). Bariatric surgery appears to alter the intestinal microbiota positively, lowering the population of the *Firmicutes phylum* [9]. However, most patients experience abdominal symptoms after bariatric surgery, including abdominal pain, bloating, flatulence, and belching. Modification of normal gut anatomy after RYGBP may induce bacterial stasis that could facilitate SIBO [7].

Obese patients have different eating patterns. Obese subjects with SIBO consume more significant amounts of refined sugars and carbohydrates, quickly metabolized by the intestinal flora and used as a source of energy for its replication. This could constitute a favorable environment for bacterial overgrowth [8]. Cani et al. demonstrated that a high fat/sugar diet leads to the production of bacterial metabolites, which can reduce insulin sensitivity [10]. The dietary modulation of the intestinal microbiota can improve the metabolic profile: a diet that is poor in carbohydrates and rich in fibers induces an increase in *Bacteroides* [8].

An increasing number of studies suggest that the gut microbiota can affect host appetite via intestinal satiety pathways and complex feeding behavior. The connection between bacteria and the central and peripheral nervous system is associated with signaling neurotransmitters and neuropeptide alterations. Gut microbiota affects the vagal nerve and brain regions, including the hypothalamus, mesolimbic system, and prefrontal cortex, which play key roles in regulating feeding behavior. Disbalance in the gut microbiota in obese patients could relate to a preference for more caloric food [11].

OBJECTIVES

Our goal was to investigate the prevalence of SIBO after bariatric surgery procedures, its influence on symptoms, and the urge to diagnose it after such procedures.

METHODS

A systematic search in PubMed was performed using the following searching criteria: (SIBO bariatric surgery) and (SIBO bypass) and (SIBO and RYGBP) and (small bowel bacterial overgrowth and bariatric surgery) and (small bowel bacterial overgrowth and bypass) and (small bowel bariatric surgery and RYGBP). To be eligible for this research, the study had to be either a cohort study or a cross-sectional study with two groups of participants after a bariatric surgery procedure and compare the prevalence of SIBO between the two groups. All bariatric surgery procedures were included.

RESULTS

A total of 14 articles were found using these search criteria. After the exclusion of 3 articles, 11 articles met the inclusion criteria.

SIBO was positive in 40% of asymptomatic patients, 83 of symptomatic patients after RYGB, and 10% after AGB. Abdominal symptoms are common after RYGB, but none were specific for SIBO-positive patients.

DISCUSSION

RYGB has been the gold standard bariatric procedure, with 60–70% excess weight loss in two years and significant improvement in glycemic control in diabetic patients [12]. The surgical procedure creates a small pouch derived from the stomach, bypassing the main portion of the stomach and most of the duodenum; the pouch is

connected to the distal jejunum forming a "Y" with the bypassed stomach and proximal duodenal components of the digestive tract [13]. Besides altering the anatomy of the gastrointestinal tract and the secretion of intestinal hormones, bariatric surgery also changes the intestinal microbiota and facilitates the development of SIBO [14].

The presence of SIBO after RYGB depends on whether the cohort of tested patients had previous abdominal symptoms or whether the cohort of tested patients was asymptomatic and symptomatic. Sabate et al. found that 15,4% of patients before bariatric surgery were SIBO positive, and 40% were SIBO positive after the RYGB procedure [7]. Their study was the only one that included symptomatic and asymptomatic patients. In a large study with 271 patients, Dolan et al. reported the prevalence of SIBO in 73,4% of patients, all of whom were symptomatic [15]. Mouillot et al. reported an even higher prevalence of SIBO after RYGB in symptomatic patients, which was 83% [5]. This leads us to the conclusion that the prevalence of SIBO is much higher in symptomatic patients after RYGB, but the prevalence is also high in asymptomatic patients. More studies need to be done with asymptomatic and symptomatic patients to evaluate the actual prevalence of SIBO in such a cohort.

Most studies evaluated the prevalence of SIBO after RYGB, which is the most used bariatric procedure. Sabate et al. found that adjustable gastric banding (AGB) is not associated with the prevalence of SIBO, as the glucose breathing test (GBT) was positive only in 10% of patients [7]. Mouillot et al. included patients with RYGB, anastomosis gastric bypass, and sleeve gastrectomy and reported no significant difference according to the type of surgery [5]. This lack of difference between the surgical techniques was even more surprising, as the omega bypass is more at risk of malabsorption [5]. The alteration of intestinal peristalsis, with an omega-shaped loop, could be a risk factor for SIBO [16]. Bastos et al. evaluated the gut microbiota in rat models. They reported that regardless of the blind loop, gut-shortening groups recorded similarly high levels of bacterial concentrations in intestine compartments [17].

RYGB was designed based on the short biliopancreatic and alimentary limbs only to prevent bile reflux to the gastric pouch. Bariatric surgeons currently commonly choose options for longer limbs. Gut shortening intended for therapeutic purposes may affect the normal physiology of the gastrointestinal tract, such as the well-coordinated signaling for gut microbiota balance. According to several studies, bariatric procedures may cause long-term gut microbial composition and diversity changes. Bastos et al. reported that the shortening of the gut is the primary factor for developing SIBO. Some old studies claimed that the blind loop is a potential bacterial reservoir. Bastos et al. contradicted these old paradigms with their research, where they proved that the gut shortening itself and not the blind loop was the reason for bacterial overgrowth. It would seem that the more extensive the gut shortening, the more at risk the patients are for developing SIBO after bariatric procedures [17].

Abdominal symptoms are common in patients undergoing RYGB, often prompting extensive diagnostic workups [18]. SIBO is a syndrome that may cause undesirable gastrointestinal symptoms, including diarrhea, abdominal pain, bloating, malabsorption, and anemia [19]. Bloating is considered the most common symptom related to SIBO [20]. This symptom worsens during the first year after surgery and may affect 57% of individuals after RYGB [21]. Sabate et al. found in their study that two-thirds of patients had at least one digestive symptom after RYGB, but none of them, including diarrhea, rumbling, or abdominal pain, were more frequent in the case of SIBO [7]. In a study performed on 215 patients before and

after different bariatric surgery procedures, 86 patients completed the GIQLI questionnaire showing a worsening of abdominal pain, bloating, flatulence, and abdominal noises. At the same time, diarrhea remained unchanged [22]. These symptoms are typical for SIBO but are also non–specific and are common regardless of SIBO presence. Because there are no differences between symptoms in SIBO-positive and SIBO-negative patients, breathing tests are a valuable diagnostic tool in diagnosing SIBO. In contrast to Sabate et al., Dolan et al. compared symptoms between SIBO-positive patients and native anatomy and SIBO-positive patients after RYGB and discovered that nausea, vomiting, bloating, and diarrhea were more commonly reported after RYGB [15].

Different microorganisms are part of the human microbiota, which varies between individuals giving them personalized microbiological identities. Bays et al. have observed in rats that the process of body fat accumulation by microbiota includes various mechanisms. The most important is the increase of digestive enzymes for carbohydrates that lead to an increase of the intestinal absorption of monosaccharides, the reduction of hepatic and muscular fat oxidation, increased absorption of nutrients by increasing capillary density of vessels of the small intestine, effects on appetite and satiety and neurobehavioral brain centers [9].

The key to the origin of various pathologies seems to be the quantitative and qualitative imbalance of these microorganisms. Studies have shown that the intestinal microbiota alters positively after bariatric surgery procedures. The *Firmicutes/Bacteroidetes* ratio seems to lower during the loss of weight. In contrast, in obese patients before the operation, there is a lower rate of *Bacteroidetes* in relation to *Firmicutes*. The *Firmicutes phylum* includes genera, many of which have better efficiency of calorie take-up than *Bacteroidetes*. Compared to lean volunteers, a higher level of short-chain fatty acid has been found in obese patients, linked with different microbiota profiles [9]. As *Firmicutes* have better efficiency of calorie take-up than *Bacteroidetes*, these changes in microbiota could be the explanation for obesity by giving an additional amount of energy. In their study, Sabate et al. found that interestingly for RYGB, despite lower caloric intakes, patients with SIBO had significantly lower weight loss and percent total weight loss [7]. These could lead to the conclusion that some changes in the microbiota in SIBO-positive patients are connected to slight weight loss.

These studies had some limitations. The authors used different modalities of glucose, from 25g of glucose to 50g of glucose, because there is no standard method for diagnosing SIBO with GBT. The protocol by Gasbarrini et al. (2009) suggests offering 50g of glucose for SIBO after RYGB. Still, some authors decided to reduce the amount of glucose provided to avoid developing dumping symptoms. Such a change could influence the test's sensitivity but compromise its specificity.

In our study, which is currently still ongoing, we investigate the prevalence of SIBO after different bariatric bypass surgery procedures, including RYGB and one anastomosis – gastric bypass. Until now, we have found similar results in the prevalence of SIBO after bypass procedures, 41,8%. We are evaluating differences in symptoms, eating patterns, and general health indicators to investigate if there are any differences between SIBO-positive and SIBO-negative groups.

The focus of our study is on liver damage due to SIBO. The liver is a significant target for gut microbes due to the anatomical and functional association between the gut and the liver. The permeability of the intestinal barrier increases in the case of SIBO, which promotes bacterial translocation together with bacterial products, especially LPS. Endotoxemia is likely to activate

TLR-4 and CD14 receptors by stimulating the expression of NF-κB. NF-κB mediates the production of proinflammatory cytokines, such as tumor necrosis factor α (TNF-α), interleukin (IL)-1 β, IL-6, and IL-8. Production of these cytokines contributes to the development of inflammation and insulin resistance and may be essential in the pathogenesis of non-alcoholic steatohepatitis, liver fibrosis, and hepatocellular carcinoma [23]. Our study compares liver pathology between the SIBO-positive and SIBO-negative groups based on NAFLD activity score. We are also evaluating biochemistry liver values between the SIBO-positive and SIBO-negative groups.

CONCLUSION

Studies confirm the high prevalence of SIBO in patients with morbid obesity after bariatric surgery. Especially high prevalence of SIBO is reported in symptomatic patients, reaching up to 83%. Symptoms are very common after bariatric procedures and can impact life quality but do not differ significantly between SIBO-positive and SIBO-negative groups. Therefore, breathing tests are valuable diagnostic tools for SIBO. This data highlights the importance of diagnosing SIBO after such procedures because of its involvement in other disease states, exacerbating other diseases, and improving the quality of life.

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Conflicts of Interest: None declared.

Consent for publication: Not applicable.

REFERENCES

1. Villanueva-Millán MJ, Pérez-Matute P, Oteo JA. Gut microbiota: a key player in health and disease. A review focused on obesity. Journal of Physiology and Biochemistry. 2015 Sep 19;71(3):509–25.

2. Bures J, Cyrany J, Kohoutova D, et al. Small intestinal bacterial overgrowth syndrome. World Journal of Gastroenterology. 2010;16(24):2978–90.

3. Miazga A, Osiński M, Cichy W, et Al. Current views on the etiopathogenesis, clinical manifestation, diagnostics, treatment and correlation with other nosological entities of SIBO. Vol. 60, Advances in Medical Sciences. Medical University of Bialystok; 2015. p. 118–24.

4. Rao SSC, Bhagatwala J. Small Intestinal Bacterial Overgrowth: Clinical Features and Therapeutic Management. Vol. 10, Clinical and translational gastroenterology. NLM (Medline); 2019. p. e00078.

5. Mouillot T, Rhyman N, Gauthier C. et al. Study of Small Intestinal Bacterial Overgrowth in a Cohort of Patients with Abdominal Symptoms Who Underwent Bariatric Surgery. Obesity Surgery. 2020 Jun 1;30(6):2331–7.

6. Madrid AM, Poniachik J, Quera R, et al. Small intestinal clustered contractions and bacterial overgrowth: A frequent finding in obese patients. Digestive Diseases and Sciences. 2011 Jan;56(1):155–60.

7. Sabate JM, Coupaye M, Ledoux S, et al. Consequences of Small Intestinal Bacterial Overgrowth in Obese Patients Before and After Bariatric Surgery. Obesity Surgery. 2017 Mar 1;27(3):599–605.

8. Ierardi E, Losurdo G, Sorrentino C, et l. Macronutrient intakes in obese subjects with or without small intestinal bacterial overgrowth: An

alimentary survey. Scandinavian Journal of Gastroenterology. 2016 Mar 3;51(3):277–80.

9. Wzgner NRF, Zaparolli MR, Cruz MRR, et al. Postoperative changes in intestinal microbiota and use of probiotics in Roux-en-y gastric bypass and sleeve vertical gastrectomy: An integrative review. Vol. 31, Arquivos Brasileiros de Cirurgia Digestiva. Colegio Brasileiro de Cirurgia Digestiva; 2018.

10. Cani PD, Amar J, Iglesias MA, et al. Metabolic endotoxemia initiates obesity and insulin resistance. Diabetes. 2007 Jul;56(7):1761–72.

11. Yu KB, Hsiao EY. Roles for the gut microbiota in regulating neuronal feeding circuits. Vol. 131, Journal of Clinical Investigation. American Society for Clinical Investigation; 2021.

12. Schauer PR, Kashyap SR, Wolski K, et al. Bariatric Surgery versus Intensive Medical Therapy in Obese Patients with Diabetes. New England Journal of Medicine. 2012 Apr 26;366(17):1567–76.

13. Coelho LK, Carvalho NS, Navarro-Rodriguez T, et al..Lactulose Breath Testing Can Be a Positive Predictor Before Weight Gain in Participants with Obesity Submitted to Roux-en-Y Gastric Bypass. Obesity Surgery. 2019 Nov 1;29(11):3457–64.

14. Ramori Farinha Wagner N, Rizzon Zaparolli Ramos M, de Oliveira Carlos L, , et al. Effects of Probiotics Supplementation on Gastrointestinal Symptoms and SIBO after Roux-en-Y Gastric Bypass: a Prospective, Randomized, Double-Blind, Placebo-Controlled Trial. Available from: https://doi.org/10.1007/s11695-020-04900-x

15. Dolan RD, Baker J, Harer K, et al. Small Intestinal Bacterial Overgrowth: Clinical Presentation in Patients with Roux-en-Y Gastric Bypass. Available from: https://doi.org/10.1007/s11695-020-05032-y

16. Bohm M, Siwiec RM, Wo JM. Diagnosis and management of small intestinal bacterial overgrowth. Vol. 28, Nutrition in Clinical Practice. 2013. p. 289–99.

17. Bastos EL de S, Liberatore AMA, Tedesco RC, Koh IHJ. Gut Microbiota Imbalance Can Be Associated with Non-malabsorptive Small Bowel Shortening Regardless of Blind Loop. Obesity Surgery. 2019 Feb 15;29(2):369–75.

18. Schulman AR, Thompson CC. Abdominal pain in the roux-en-Y gastric bypass patient. American Journal of Gastroenterology. 2018 Feb 1;113(2):161–6.

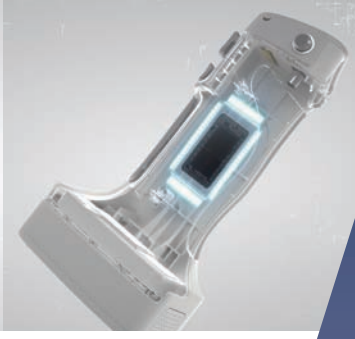
19. Saffouri GB, Shields-Cutler RR, Chen J, et al. Small intestinal microbial dysbiosis underlies symptoms associated with functional gastrointestinal disorders. Nature Communications. 2019 Dec 1;10(1).

20. Pimentel M, Saad RJ, Long MD, Rao SSC. ACG Clinical Guideline: Small Intestinal Bacterial Overgrowth. Am J Gastroenterol. 2020 Feb 1;115(2):165–78.

21. el Labban S, Safadi B, Olabi A. The Effect of Roux-en-Y Gastric Bypass and Sleeve Gastrectomy Surgery on Dietary Intake, Food Preferences, and Gastrointestinal Symptoms in Post-Surgical Morbidly Obese Lebanese Subjects: A Cross-Sectional Pilot Study. Obesity Surgery. 2015 Dec 1;25(12):2393–9.

22. Lee WJ, Lee MH, Yu PJ et al. Gastro-intestinal Quality of Life After Metabolic Surgery for the Treatment of Type 2 Diabetes Mellitus. Obesity Surgery. 2015 Aug 23;25(8):1371–9.

23. Augustyn M, Grys I, Kukla M. Small intestinal bacterial overgrowth and nonalcoholic fatty liver disease. Vol. 5, Clinical and Experimental Hepatology. Termedia Publishing House Ltd.; 2019. p. 1–10.



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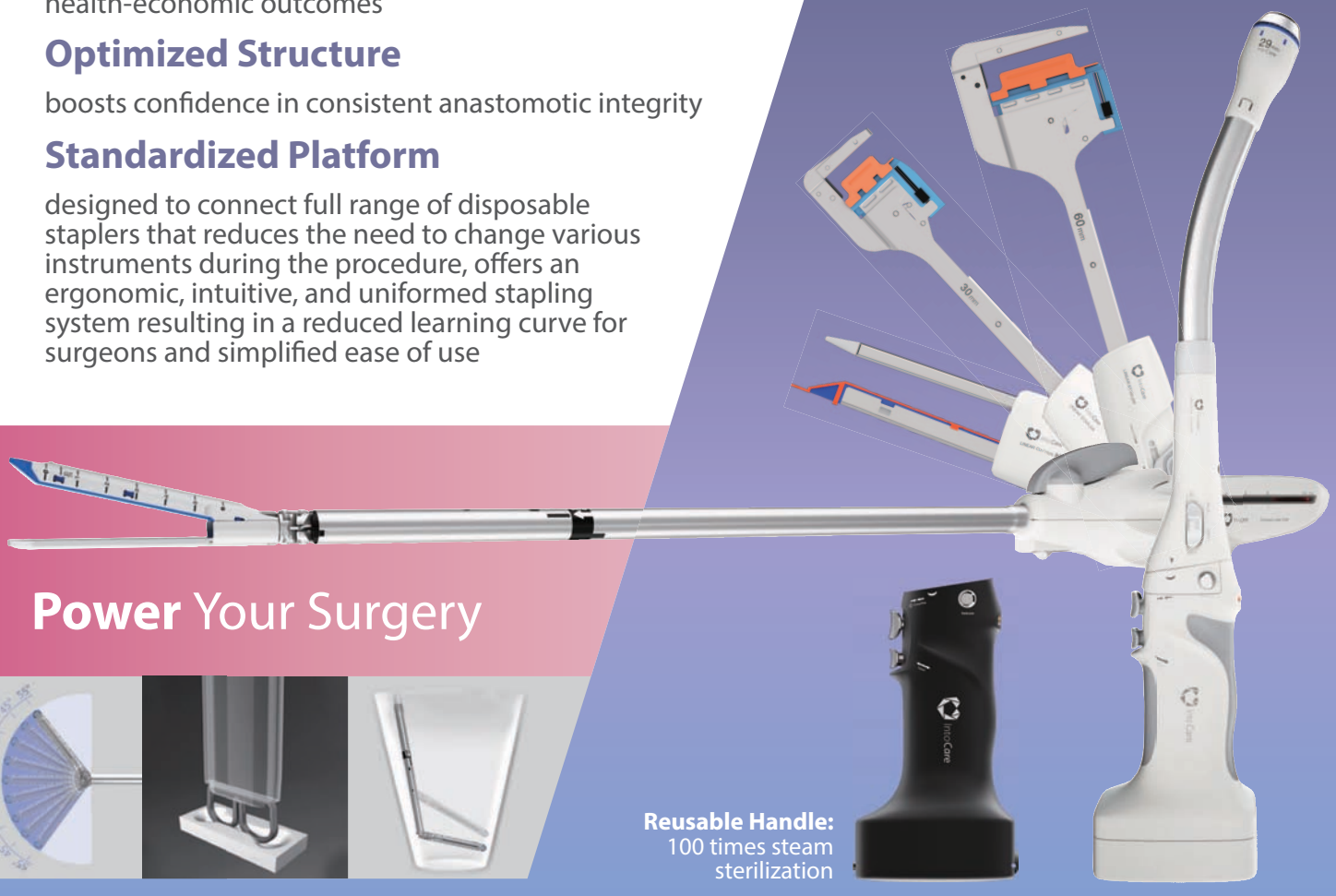

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