Combined Endoscopic Negative Pressure and Surgical Treatment of Anastomotic Insufficiencies following Oncological Gastrectomy – Recent Results

Doerte Wichmann (✉ doerte.wichmann@med.uni-tuebingen.de)

University Hospital of Tuebingen <https://orcid.org/0000-0002-8832-5031>

Dietmar Stüker

Universitätsklinikum Tübingen Universitätsklinik für Allgemeine Viszeral- und Transplantationschirurgie

Karolin Thiel

Universitätsklinikum Tübingen Universitätsklinik für Allgemeine Viszeral- und Transplantationschirurgie

Jessica Lange

Universitätsklinikum Tübingen Universitätsklinik für Allgemeine Viszeral- und Transplantationschirurgie

Ulrike Schempf

Universitätsklinikum Tübingen Medizinische Universitätsklinik

Christoph R. Werner

Universitätsklinikum Tübingen Medizinische Universitätsklinik

Alfred Königsrainer

Universitätsklinikum Tübingen Universitätsklinik für Allgemeine Viszeral- und Transplantationschirurgie

Ulrich Schweizer

Universitätsklinikum Tübingen Universitätsklinik für Allgemeine Viszeral- und Transplantationschirurgie

Volker Steger

Universitätsklinikum Tübingen Universitätsklinik für Herz-, Thorax- und Gefäßchirurgie und Transplantationschirurgie

Helene Anna Häberle

Universitätsklinikum Freiburg Klinik für Anesthesiologie und Intensivmedizin

Rami Archid

Universitätsklinikum Tübingen Universitätsklinik für Allgemeine Viszeral- und Transplantationschirurgie

Research article

Keywords: Endoscopic negative pressure therapy (ENPT), open-pore film drain (OFD), oncological gastric resection, anastomotic insufficiency, complications management

Posted Date: July 16th, 2020

DOI: <https://doi.org/10.21203/rs.3.rs-39681/v1>

License: This work is licensed under a Creative Commons Attribution 4.0 International License.

[Read Full License](#)

Abstract

Background and study aims: Management of esophago-jejunal anastomotic leakages (EJAL) following gastrectomy is challenging. Endoscopic negative pressure therapy (ENPT) is an emerging effective tool for treatment of gastrointestinal and anastomotic leaks. We have been using ENPT as first line therapy for EJAL after oncological gastric resections since 2018. The aim of the study was to present our results with this strategy in a case series.

Methods: Nine consecutive patients were treated with ENPT for EJAL after oncological gastrectomy between 01.2018 and 12.2019. A retrospective analysis of patients' and treatment-related data was performed.

Results: Time to leakage detection was 6.00 ± 2.49 days after surgery. After 14.78 ± 9.66 days of ENPT, 6.25 ± 3.65 endoscopies and 38.11 ± 16.46 days of hospitalization, endoscopic treatment with ENPT combined with surgical debridement and drainage for sepsis control was effective in eight of nine patients. In one patient with a complete anastomotic dehiscence, treatment was changed to a stent-based therapy combined with surgery.

Conclusions: ENPT is a new and promising option in the complication management of patients with anastomotic insufficiencies following oncological gastrectomy. It can be recommended in combination with limited surgery to preserve the anastomosis and provide sepsis control. The time interval to diagnosis and the size of the insufficiency are important for the success of ENPT in patients with EJAL.

Background

Gastric cancer is one of the leading causes of cancer-related death in the world, and multimodal treatment combining perioperative chemotherapy with radical resection and D2 lymphadenectomy is the established curative treatment. For subtotal and complete gastrectomy, the digestive reconstruction is performed with a Roux-en-Y or jejunal interposition, both of which include anastomosis between the esophagus/stomach remnant and jejunum. Esophagojejunal anastomotic leakage (EJAL) is still one of the most serious complications with an EJAL incidence between 0.5% and 11.0% associated with a high mortality rate [1-3].

Endoscopic negative pressure therapy (ENPT) has become a promising tool for managing complications after surgery in both the upper or lower gastrointestinal tract [4-8]. ENPT improves local perfusion, resolution of interstitial wound edema, removal of fluids, and debridement of the wound ground [9-11]. Vital granulation tissue is formed after wound cleaning.

For endoluminal ENPT, the open-pore drainage system is placed within the lumen of the digestive tract at the entrance to the extraluminal cavity. This method can be used when the defects and cavities are small [11, 12][11, 12]. ENPT success for esophageal leaks has been reported since 2010 [5-8, 13-15]. Following the promising results and the increased use of this method in Europe, encouraging reports on the practice

of endoluminal ENPT have been published worldwide. For endoluminal ENPT we used a drain covered by an open-pore polyurethane sponge (OPD: open-pore polyurethane sponge drain) or a handmade open-pore film drain (OFD). Characteristics of both open-pore devices are listed in **Table 1**.

After implementation of an SOP at our center, ENPT with OPD or OFD in endoluminal position has been the primary endoscopic therapeutic option for EJAL since January 2018. Before endoluminal ENPT became the standard for complication management for EJAL, stenting with self-expandable metal stents (SEMS) was our tool for management of this complication. Stent dislocations and stent-related complications like pressure ulcer and bleeding were the reasons for changing our EJAL complication management. The aim of this study is to present our results with ENPT in patients with EJAL.

Methods

Study design:

The local ethics committee of Tübingen University Hospital, Germany, approved this study (AZ: 752/2019B02). The study is registered with ClinicalTrials.gov under reference number NCT04362605. The study adheres to the PROCESS guidelines from 2016.

All EJAL patients treated primarily with ENPT between January 2018 and December 2019 were considered for the study. Ethics Approval and Consent to Participate whether informed consent was obtained from all participants. Patients' records as well as the database were analyzed for EJAL therapy-specific items. EJAL is defined according to the definition of anastomotic insufficiencies following esophageal or cardiac resection of 2018 [16].

Endoscopic negative pressure therapy (ENPT):

OPD: The commercially available Eso-SPONGE® System (B. Braun Melsungen AG, Melsungen, Germany) was used for endoluminal vacuum therapy. For positioning the OPD in loop-technique a loop (Mersilene™, Polyester, 4 Ph. Eur., Ethicon®, Norderstedt, Germany) is fixed at the distal end of the drain, gripped with an endoscopic grasper and placed under endoscopic view. Endoscopic placement was performed via oral intubation of the esophagus and finally with oro-nasal redirection and fixation with plasters. The OPD with placed suture loop is illustrated in **Figure 1**.

OFD: The OFD for endoluminal therapy is handmade, as previously described by G. Loske et al. [11], by wrapping a thin open-pore double-layered drainage film (Suprasorb® CNP, Drainage Film; Lohmann & Rauscher International GmbH & Co.KG, Rengsdorf, Germany) around the distal end of a small caliber redon drain, a gastric tube or the gastric segment of a naso-jejunal feeding tube (Freka® Trelumina, Fresenius Kabi Deutschland GmbH, Bad Homburg, Germany). Sutures (Mersilene™, Polyester, 4 Ph. Eur., Ethicon®, Norderstedt, Germany) were used for fixation of the drainage film around the tube. Drain insertion took place via nasal positioning and endoscopic guiding with a grasper. Venting tubes in tri-

lumen enteral feeding tubes had to be closed for ENPT. The handmade OFD on an intestinal feeding tube is shown in **Figure 2**.

Controlled Negative Pressure: A continuous vacuum of -125mmHg is generated with electronic vacuum devices (KCI V.A.C. Ulta or V.A.C. Freedom; KCI USA Inc., San Antonio, TX, USA).

Procedural information: In patients with suspected EJAL first an index endoscopy was performed under general anesthesia with endotracheal intubation. Standard gastroscopes with an outer diameter of 9.8mm were used with carbon dioxide insufflation.

Definition of an anastomotic leak is based on the endoscopic finding at the esophago-jejunostomy according to the CAES classification [16]. Extraluminal fluids and gases are radiologically assessed. Decision criteria for placement of OPD or OFD were the defect size, the extension of extraluminal collection and the patient's clinical condition. A CT scan in patients with suspected EJAL was done in all cases before or after endoscopy. Extraluminal collections were drained via limited surgical procedure as part of the presented concept.

Re-endoscopy and ENPT device change were performed after three to seven days until resolution of the complication. In patients with OPD change interval was three to four days, while in patients treated with OFD the interval was longer, namely up to seven days. Success was defined as complete closure of the perforation.

In patients with a compensated clinical condition and endoluminal OFD the swallowing of liquids is allowed.

Database:

An analysis was performed using SPSS v. 24.0.0.1 (IBM, Armonk, NY, USA). Data were presented as means $\pm$ SD.

Results

Nine consecutive patients (4 females and 5 males with a mean age of 60.67 ± 12.35 years) were treated with ENPT for EJAL. Patients' characteristics are presented in **Table 2**.

Mean time of EJAL diagnosis was day 6.00 ± 2.49 after surgery. Three patients were treated at the ICU at the time of diagnosis. Symptoms that led to a more in-depth diagnosis were respiratory insufficiency, conspicuous secretion via drains, fever, and elevated inflammatory markers. After diagnosis of EJAL and start of ENPT all patients were treated and observed on ICU.

Index endoscopy findings varied strongly. Circumscribed insufficiencies, large leakages with secretion of putrid fluids or fibrin-coated anastomosis with exposed clamps were seen. Endoscopic findings are

classified according to the CAES classification [16]. **Figures 3** and **4** show examples of endoscopic findings.

First treatment mode in all patients with EJAL was endoluminal ENPT. In five patients ENPT was performed with OPD and in four patients with OFD. In one obese patient with a complete anastomotic rupture ENPT was changed to SEMS therapy. **Table 3** shows an overview of treatment-related characteristics per EJAL patient according to CAES classification. Treatment characteristics are summarized in **Table 4**.

To address extraluminal collection and sepsis control surgical debridement and drainage were performed in eight of nine patients. Enteral feeding was established in all patients via nutrition tubes combined with ENPT through OFD in five patients and via needle catheter jejunostomy in three patients.

In eight patients the combined treatment with ENPT and surgery was successful.

Later endoscopic intervention for post-treatment of a stenosis of the anastomosis was not necessary in the analyzed patients.

Discussion

Because of multimodal treatment of gastric cancer the majority of patients with EJAL after gastrectomy are critically ill. The analyzed patients had a prolonged postoperative course. All were treated on the ICU/IMC and required invasive ventilation or closer monitoring.

For management of a suspected EJAL an SOP has been established with a generous indication for endoscopy in any case of worsening of the clinical condition or suspicion of an anastomosis problem. In most cases endoscopy is done before the CT scan and allows immediate treatment for either ENPT placement or stent placement.

Several articles favor the primary use of self-expandable fully or partially covered metal stents or sealing the leak with clips in patients with EJAL [3, 17-20]. Both techniques lead to a more or less closing of the defect without addressing the extraluminal infected focus or fluid collection. In our experience the use of stents for this indication is critical and reserved for patients with failed ENPT. Only one of our patients needed a stent after failed ENPT. Advanced clip systems like the over the scope clip (OTSC) system are used to close fresh perforations of the gastrointestinal tract as well as anastomotic leakages, but good perfusion of the wound edges is a prerequisite. We have no experience with the OTSC in EJAL patients.

ENPT is an effective endoscopic and minimally invasive option for the management of anastomotic insufficiencies of the upper and lower gastrointestinal tract [6-8, 11-14, 21]. First case reports about ENPT for the treatment of EJAL were given by G. Loske [4] and J. Wedemeyer and G. Loske [8]. From these first reports to the current time overall around 55 cases of EJAL treated with ENPT have been published. Besides different case reports five articles are available with case series of 15 [22], 14 [23], nine [24], nine

[25] and five [26] EJAL patients. Articles reporting on ENPT for EJAL are listed in **Table 5**. Most of the described EJAL cases were in patients with mixed indications [9, 10, 20, 23-28].

The value of this strategy is well documented with excellent results in patients who experienced insufficiencies of the staple line after sleeve gastrectomy [29, 30].

In this article we focus on the primary endoscopic treatment in patients who suffered from EJAL exclusively after oncological gastrectomy. The advantages of ENPT are internal endoluminal drainage, stimulation of granulation of the surrounding tissue followed by size reduction of the wound and finally preservation of the anastomosis. Complications associated with the use of stents such as migration, damage to the digestive wall, postinterventional stenosis, low tolerability, and high rates of dysphagia can be prevented with ENPT. Hemorrhage due to negative pressure is a possible complication of ENPT; it is documented in some patients with intracavitary position of the sponge (OPD) [24]. No bleeding complication occurred in patients treated with ENPT with open-pore devices in endoluminal position.

Possible disadvantages of EJAL are the limited possibility for enteral feeding and repeat endoscopies. The former can be ensured with a combined feeding tube as well as the possibility to swallow liquids in cases with OFD. A re-endoscopy interval of three to five days ensured good assessment of the anastomotic region and leak healing with the possibility to immediately change strategy in the case of treatment failure.

The decision for the open-pore device, the use of OPD or OFD, in endoluminal position is taken by the endoscopist together with the surgeon focusing on the endoscopic and radiological findings and the patient's condition. Because of the very good cleaning properties and wound size reduction effect of OPD, this device is favored by us for large insufficiencies and dirty wound ground.

In further studies the questions for the best time and usage of the different open-pore devices have to be answered.

Additional surgery as re-laparotomy, re-laparoscopy or re-thoracoscopy depends on primary operation, endoscopic and radiological findings. Surgery is needed to address the extraluminal infection focus.

We are aware of the limitations of this retrospective small case series, but to the best of our knowledge this is the first case series of primary ENPT performed in EJAL patients exclusively after oncological gastrectomy. The excellent results with complete healing of the anastomosis in eight of nine treated patients have led us to change our treatment algorithm. ENPT is now the primary treatment option in patients with EJAL.

Conclusion

ENPT is a promising new tool for treating EJAL. Furthermore, comparative studies of ENPT and other endoscopic treatment options for EJAL are needed to determine the best management options and indications for combined surgery.

We recommend ENPT in endoluminal position in EJAL patients combined with additional surgery, if required to treat a pleural or abdominal septic focus.

Abbreviations

CAES = Working Group of Surgeons for Endoscopy and Ultrasound of the German Society of Surgery

EJAL = Esophagojejunal anastomotic leakage

ENPT = Endoscopic negative pressure therapy

OFD = Open-pore Film Drain

OPD = Open-pore Polyurethane sponge Drain

OTSC = Over-The-Scope Clip

SEMS = Self-Expandable Metal Stent

Declarations

Ethics approval and consent to participate

This study was approved by the ethics committee of the University Hospital of Tübingen (AZ: 752/2019B02). The study is registered with ClinicalTrials.gov under reference number NCT04362605. Ethics Approval and Consent to Participate whether informed consent was obtained from all participants.

Trial registration:

ClinicalTrials.gov; NCT04362605. Registered 27 April 2020 - Retrospectively registered, <https://clinicaltrials.gov/ct2/show/NCT04362605?term=NCT04362605&draw=2&rank=1>

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

Availability of data and material

The datasets generated and/or analyzed during the current study are not publicly available due to protecting individual patient privacy but are available from the corresponding author on reasonable request.

Funding

Not applicable.

Authors' contributions

DW, AK and RA contributed to the conception and design. DS, KT, JL, US, CRW, US, VS and HAH are responsible for the provision of the study materials and data collection. DW, AR and AK contributed to the data analysis and interpretation and draft writing equally. All authors read and approved the final manuscript.

References

1. Deguchi Y, Fukagawa T, Morita S, Ohashi M, Saka M, Katai H. Identification of risk factors for esophagojejunal anastomotic leakage after gastric surgery. *World J Surg.* 2012;36(7):1617–22.
2. Oshi M, Kunisaki C, Miyamoto H, Kosaka T, Akiyama H, Endo I. Risk Factors for Anastomotic Leakage of Esophagojejunostomy after Laparoscopy-Assisted Total Gastrectomy for Gastric Cancer. *Dig Surg.* 2018;35(1):28–34.
3. Gong W, Li J. Combat with esophagojejunal anastomotic leakage after total gastrectomy for gastric cancer: A critical review of the literature. *Int J Surg.* 2017;47:18–24.
4. Loske G, Muller C. [Vacuum therapy of an esophageal anastomotic leakage—a case report]. *Zentralbl Chir.* 2009;134(3):267–70.
5. Loske G, Schorsch T. Intraluminal Vacuum Therapy - A New Endoscopic Approach in the Treatment of Duodenal Leakage. *Endoskopie Heute.* 2010;23(4):267–9.
6. Loske G, Schorsch T, Muller C. Endoscopic intracavitary vacuum sponge therapy of anastomotic leakage in the proximal colon after right-sided colectomy. *Endoscopy.* 2010;42(Suppl 2):E171–2.
7. Wallstabe I, Plato R, Weimann A. Endoluminal vacuum therapy for anastomotic insufficiency after gastrectomy. *Endoscopy.* 2010;42:E165–6.
8. Wedemeyer J, Schneider A, Manns MP, Jackobs S. Endoscopic vacuum-assisted closure of upper intestinal anastomotic leaks. *Gastrointest Endosc.* 2008;67(4):708–11.
9. Kuehn F, Schiffmann L, Janisch F, Schwandner F, Alsfasser G, Gock M, Klar E. Surgical Endoscopic Vacuum Therapy for Defects of the Upper Gastrointestinal Tract. *J Gastrointest Surg.* 2016;20(2):237–43.
10. Loske G. Endoscopic negative pressure therapy of the upper gastrointestinal tract. *Chirurg.* 2019;90(Suppl 1):1–6.
11. Loske G, Muller CT. Tips and tricks for endoscopic negative pressure therapy. *Chirurg.* 2019;90(Suppl 1):7–14.
12. Loske G, Schorsch T, Muller C. Intraluminal and intracavitary vacuum therapy for esophageal leakage: a new endoscopic minimally invasive approach. *Endoscopy.* 2011;43(6):540–4.

13. Loske G, Schorsch T, Mueller CT. Endoscopic intraluminal vacuum therapy of duodenal perforation. *Endoscopy*. 2010;42(Suppl 2):E109.
14. Loske G, Schorsch T, Muller C. Endoscopic vacuum sponge therapy for esophageal defects. *Surg Endosc*. 2010;24(10):2531–5.
15. Loske G, Schorsch T, Muller C. Endoscopic intracavitary vacuum therapy of Boerhaave's syndrome: a case report. *Endoscopy*. 2010;42(Suppl 2):E144–5.
16. Schaible A, Schmidt T, Diener M, Hinz U, Sauer P, Wichmann D, Konigsrainer A. [Intrathoracic anastomotic leakage following esophageal and cardial resection: Definition and validation of a new severity grading classification]. *Chirurg*. 2018;89(12):945–51.
17. Messenger M, Warlaumont M, Renaud F, Marin H, Branche J, Piessen G, Mariette C. Recent improvements in the management of esophageal anastomotic leak after surgery for cancer. *Eur J Surg Oncol*. 2017;43(2):258–69.
18. Carboni F, Valle M, Federici O, Levi Sandri GB, Camperchioli I, Lapenta R, Assisi D, Garofalo A. Esophagojejunal anastomosis leakage after total gastrectomy for esophagogastric junction adenocarcinoma: options of treatment. *J Gastrointest Oncol*. 2016;7(4):515–22.
19. Lee HL, Cho JY, Cho JH, Park JJ, Kim CG, Kim SH, Han JH. Efficacy of the Over-the-Scope Clip System for Treatment of Gastrointestinal Fistulas, Leaks, and Perforations: A Korean Multi-Center Study. *Clin Endosc*. 2018;51(1):61–5.
20. Mennigen R, Colombo-Benkmann M, Senninger N, Laukoetter M. Endoscopic closure of postoperative gastrointestinal leakages and fistulas with the Over-the-Scope Clip (OTSC). *J Gastrointest Surg*. 2013;17(6):1058–65.
21. Schorsch T, Muller C, Loske G. Endoscopic vacuum therapy of anastomotic leakage and iatrogenic perforation in the esophagus. *Surg Endosc*. 2013;27(6):2040–5.
22. Bludau M, Fuchs HF, Herbold T, Maus MKH, Alakus H, Popp F, Leers JM, Bruns CJ, Holscher AH, Schroder W, et al. Results of endoscopic vacuum-assisted closure device for treatment of upper GI leaks. *Surg Endosc*. 2018;32(4):1906–14.
23. Brangewitz M, Voigtlander T, Helfritz FA, Lankisch TO, Winkler M, Klempnauer J, Manns MP, Schneider AS, Wedemeyer J. Endoscopic closure of esophageal intrathoracic leaks: stent versus endoscopic vacuum-assisted closure, a retrospective analysis. *Endoscopy*. 2013;45(6):433–8.
24. Laukoetter MG, Mennigen R, Neumann PA, Dhayat S, Horst G, Palmes D, Senninger N, Vowinkel T. Successful closure of defects in the upper gastrointestinal tract by endoscopic vacuum therapy (EVT): a prospective cohort study. *Surg Endosc*. 2017;31(6):2687–96.
25. Schorsch T, Muller C, Loske G. [Endoscopic vacuum therapy of perforations and anastomotic insufficiency of the esophagus]. *Chirurg*. 2014;85(12):1081–93.
26. Kuehn F, Schiffmann L, Rau BM, Klar E. Surgical endoscopic vacuum therapy for anastomotic leakage and perforation of the upper gastrointestinal tract. *J Gastrointest Surg*. 2012;16(11):2145–50.

27. Smallwood NR, Fleshman JW, Leeds SG, Burdick JS. The use of endoluminal vacuum (E-Vac) therapy in the management of upper gastrointestinal leaks and perforations. *Surg Endosc*. 2016;30(6):2473–80.
28. Watkins JR, Farivar AS. Endoluminal Therapies for Esophageal Perforations and Leaks. *Thorac Surg Clin*. 2018;28(4):541+.
29. Archid R, Wichmann D, Klingert W, Nadiradze G, Hones F, Archid N, Othman AE, Ahmad SJS, Konigsrainer A, Lange J. **Endoscopic Vacuum Therapy for Staple Line Leaks after Sleeve Gastrectomy**. *Obes Surg* 2019.
30. Leeds SG, Burdick JS. Management of gastric leaks after sleeve gastrectomy with endoluminal vacuum (E-Vac) therapy. *Surg Obes Relat Dis*. 2016;12(7):1278–85.
31. Mencia MA, Ontiveros E, Burdick JS, Leeds SG. Use of a novel technique to manage gastrointestinal leaks with endoluminal negative pressure: a single institution experience. *Surg Endosc*. 2018;32(7):3349–56.

Tables

Table 1: Characteristics of used open-pore devices for ENPT in EJAL patients

Characteristics of the open-pore device	OPD	OFD
Used insertion technique	Oral	Nasal and oral
Used positioning technique	Pull	Pull
Outer diameter of device (mm)	15-30	8-12
Debridement effect	Very good	Good
Time interval to change (days)	3-4	3-7
Removal of secretions	Good	Very good
Occlusion of open-pore device	Rapid	Delayed
Granulation tissue with typical pattern	Very good	Good
Downsizing of wound cavity	Very good	Good
Adhesion to wound ground	Good adhesive	Non-adhesive

Table 2: Characteristics of EJAL patients

FLOT: 5-fluorouracil, folic acid, oxaliplatin, docetaxel

Characteristics	Specification
Sex (female:male)	4:5
Mean age (years)	60.67 ± 12.35
Neoadjuvant treatment (n) (%)	7 (77.78%)
Previously presented risk factors	
- Obesity (BMI > 35kg/m ²) (n)	1
- High age (>70 years) (n)	3
- Previous chemotherapy (n)	6
- Diabetes (n)	3
- Cachexia (BMI < 15kg/m ²) (n)	3
Characteristics of malignoma	
- Neuroendocrine carcinoma (n)	1
- Signed ring cell carcinoma (n)	3
- Gastric adenocarcinoma (n)	2
- Esophageal adenocarcinoma (n)	3
Neoadjuvant multimodal therapy in 7 patients	
- FLOT regimen total (n)	6
- FLOT regimen partial (n)	1
Mean time interval between neoadjuvant chemotherapy and oncological resection (weeks)	8.00 ± 2.31
Oncological resection (n)	
- Laparoscopic complete gastrectomy with D2 lymphadenectomy	2
- Open complete gastrectomy with D2 lymphadenectomy	
- Combined transhiatal distal esophagectomy and gastrectomy	2
- Gastrectomy extent (additional liver or colon resections)	3
	2
Oncological resection combined with hyperthermic intraperitoneal chemotherapy (HIPEC) (n) (%)	2 (25%)

Table 3: Overview of treatment-related characteristics per EJAL patient according to CAES classification [16]

Patient number	CAES classification	ENPT device used for initial treatment	Number of redo surgeries (n)	Time on ICU (days)
1	Ila	OFD	0	1
2	IIb	OFD	1	2
3	IIb	OPD	2	2
4	IIb	OPD	2	11
5	IIb	OPD	11	1
6	IIb	OPD	1	2
7	IIb	OFD	2	1
8	IIb	OPD	1	1
9	IIb	OFD	1	22

Table 4: Therapeutic data

Characteristics	Specification
Mean time interval between oncological gastrectomy and endoscopic diagnosis and treatment start (days)	6.00 ± 2.49
Number of patients requiring invasive ventilation (n)	9 (100%)
Mean duration of required ventilation (days)	5.56 ± 4.09
Treatment during first diagnostic endoscopy	
- endoluminal OFD (n)	4
- endoluminal OPD (n)	5
Change in ENPT concept	
- OFD to OPD (n)	3
- OPD to OFD (n)	4
- OPD to SEMS (n)	1
- none (n)	1
Mean number of endoscopies to change the suction system for ENPT (n)	4.89 ± 3.28
Mean time interval between endoscopies (days)	3.25 ± 0.65
Mean ENPT duration (days)	14.78 ± 9.66
Enteral feeding via (n)	
- nasojejunal tube	6
- catheter jejunostomy	3
Number of endoscopies needed per patient (n)	6.25 ± 3.65
Number of patients requiring combined surgery (n)	8 (88.89%)
Number of combined surgical procedures	
- redo laparotomy (n)	14
- redo laparoscopy (n)	1
- redo thoracoscopy (n)	5
- sewing-over of anastomosis (n)	2
- none (n)	1
ICU stay needed in patients (n) (%)	9 (100%)
Mean duration of ICU stay (days)	12.89 ± 7.98

Mean duration of hospital stay (days)	38.11 ± 16.46
ENPT success (n) (%)	8 (88.89%)

Table 5: List of publications on ENPT for EJAL

Author	Year of publication	Period analyzed	Number of patients treated for EJAL	Number of patients treated for leak of the upper GI	ENPT success in EJAL patients (n)
Bludau et al.[22]	2018	10.2010-01.2017	15	77	Not specified
Brangewitz et al.[23]	2010	01.2010-07.2011	14	32	Not specified
Kuehn et al.[26]	2012	03.2011-05.2012	5	9	Not specified
Kuehn et al.[9]	2016	03.2011-03.2015	Unspecified	21	Not specified
Laukoetter et al.[24]	2017	12.2011-12.2015	9	52	Not specified
Loske et al. [4]	2009	2009	1	1	1
Mencio et al.[31]	2017	07.2013-12.2016	Unspecified	36	Not specified
Schorsch et al.[25]	2014	11.2006-10.2013	9	35	Not specified
Wallstabe et al.[7]	2010	2010	1	1	1
Wedemeyer et al.[8]	2008	2007	1	2	1
Total:			55	266	

Figures

Figure 1

Eso-SPONGE® (B. Braun Melsungen AG, Melsungen, Germany) with a placed loop (Mersilene™, Polyester, 4 Ph. Eur., Ethicon®, Norderstedt, Germany), Page 4

Figure 2

Two open-pore film drainages, Page 5 a) A naso-jejunal feeding tube (Freka® Trelumina, Fresenius Kabi Deutschland GmbH, Bad Homburg, Germany) wrapped with drainage film (Suprasorb® CNP, Drainage Film; Lohmann & Rauscher International GmbH & Co.KG, Rengsdorf, Germany) around the distal end of the gastric segment. Fixation is done with sutures (Mersilene™, Polyester, 4 Ph. Eur., Ethicon®, Norderstedt, Germany). The yellow clamp closes the ventilation tube. b) A gastric tube (Freka® 16Ch, Fresenius Kabi Deutschland GmbH, Bad Homburg, Germany) wrapped with drainage film (Suprasorb® CNP, Drainage Film; Lohmann & Rauscher International GmbH & Co.KG, Rengsdorf, Germany) around the distal end of the gastric segment. Fixation is done with sutures (Mersilene™, Polyester, 4 Ph. Eur., Ethicon®, Norderstedt, Germany).

Figure 3

Endoscopic finding of a small EJAL (*), Page 6

Figure 4

Endoscopic finding of a complete avulsion of the anastomosis, jejunum is marked (#), insufficient area is marked (*), Page 6

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- [PROCESS.docx](#)