EUS-Guided Transgastric Drainage of Intraabdominal Fluid Collections

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Rezumat

Drenajul transgastric ecoendoscopic-ghidat al colecțiilor fluide intraabdominale

Colecțiile intraabdominale pot reprezenta o cauză semnificativă de morbiditate și mortalitate în cazul pacienților cu pancreatită acută, precum și al pacienților ce au suferit intervenții chirurgicale în general dar și pentru patologie oncologică. În prezent tratamentul este centrat pe tehnicile minim-invazive, astfel încât recuperarea pacientului să fie de scurtă durată și calitatea vieții să fie crescută. În ultima decadă, ecoendoscopia a început să fie folosită tot mai des alături de drenajele percutane și de cele chirurgicale în managementul colecțiilor perigastrice.

Obiective: Principalul obiectiv al acestei lucrări este evaluarea ratei de succes tehnic și clinic a drenajului ecoendoscopic ghidat al colecțiilor intraabdominale. Obiectivele secundare sunt urmărirea rezoluției colecțiilor intra-abdominale, apariția infecțiilor post-procedurale, supraviețuirea.

Metode: Am realizat un studiu prospectiv observațional a 31 de pacienți diagnosticați ecoendoscopic cu colecții intraabdominale fluide perigastrice, din totalul de 788 ecoendoscopii realizate într-un interval de 2 ani. Pacienții au fost urmăriți timp de 6 luni post-procedural prin examinări iterative ecografice, endoscopice, tomografice. Toți pacienții incluși în studiu au fost internați în Spitalul Clinic de Urgență București, în secțiile de gastroenterologie și chirurgie. Datele colectate au fost procesate utilizând IBM SPSS Statistics 20.

Received: 15.10.2018

Accepted: 10.12.2018

Rezultate: Vârsta medie a subiecților incluși în studiu a fost 51 de ani. Diametrul mediu al colecțiilor intraabdominale a fost de 109 mm (34-250 mm), acesta corelându-se cu metoda de tratament aleasă ($p < 0.005$): drenaj ghidat eco-endoscopic, drenaj percutan, intervenție chirurgicală, ca monoterapie sau combinații între acestea. Mortalitatea peri-procedurală a fost de 9,3%, asociată în principal cu severitatea patologiei ori cu asocierea chirurgiei în tratament.

Concluzii: În concluzie, prin studiul efectuat putem afirma că ecoendoscopia poate fi metoda de primă intenție în a drena colecțiile intra abdominale perigastrice, pentru că reprezintă o metodă sigură și eficientă, cu un success tehnic de 100% în timp ce succesul clinic de peste 80% asigură o mai bună calitate a vieții. Pentru colecțiile ce au un diametru mai mare de 127 mm, ne putem aștepta totuși la necesitate unui tratament combinat, ecoendoscopic și chirurgical.

Cuvinte cheie: colecții intraabdominale, drenaj transgastric, percutan, chirurgie, ecoendoscopie

Abstract

Intraabdominal fluid collections can be a significant cause of morbi-mortality among patients with acute pancreatitis and those who underwent surgery, especially oncological ones. Nowadays, the treatment tends to be minimally invasive, so that the patient's recovery would be shorter and the quality of life higher. EUS (endoscopic ultrasound) has emerged in the last decade to fulfill that demand, alongside percutaneous and surgical drainage in the management of perigastric collections.

Objectives: The main objective of this paper is to evaluate the efficacy of EUS guided drainage in terms of technical and clinical success. Secondary objectives refer to the assessment of complete resolution of intraabdominal collection, presence of infection after drainage, overall survival.

Methods: We conducted a prospective study by enrolling 31 patients who were diagnosed using EUS with perigastric intraabdominal fluid collections, from an overall of 788 EUS performed over a period of 2 years. We analyzed their evolution during 6 months after treatment, by regular examinations (ultrasound/endoscopic/computed tomography). All of them were in-patients of Bucharest Clinical Emergency Hospital, either in Endoscopy or in Surgery Departments. Data collected was processed in IBM SPSS Statistics 20.

Results: Overall mean age was 51 year and intraabdominal collections average was 109 mm (range 34 – 250 mm) and was correlated with the method of treatment ($p < 0.005$). Patients underwent different methods for their intraabdominal collections: EUS drainage, CT (computed-tomography)-guided percutaneous drainage, surgical intervention, alone or combined when needed. Overall mortality was 9,3% and was mainly related to the severity of the case and sepsis.

Conclusions: We conclude that endoscopic ultrasound can be the first choice for drainage of intra-abdominal perigastric fluid collections because it is a safe and effective technique with 100 % technical success, and with over 80 % clinical success assures a better quality of life. For collections with a diameter larger than 127 mm, we can expect however the need of combined treatment, EUS and surgery.

Key words: intraabdominal collections, transgastric drainage, percutaneous, surgery, endoscopic ultrasound (EUS)

Introduction

Intraabdominal fluid collections consist mainly of walled-off pancreatic necrosis (WOPN) and

pseudocysts. WOPN is derived from necrotic parenchyma and/or necrotic peripancreatic tissues and may be infected, multiple, or may be present at sites distant from the pancreas (1).

Pseudocysts are localized fluid collections, surrounded by non-epithelial wall (granulation tissue or connective tissue) that usually appear after the rupture or obstruction of a pancreatic duct. Other pseudocysts come from the liquefaction of an area of necrosis, with detritus and secretions remaining encapsulated (2). They can be intrapancreatic (usually small) or extrapancreatic. In most cases, they are delimited by the connective tissue or the surrounding organs. It is considered that a period of time of at least 4 weeks must pass from their appearance until they acquire a mature wall (3).

Another type of intraabdominal collections described in the literature to have been drained by EUS guidance are postoperative intraabdominal and pelvic fluid collections that have appeared after surgery and oncological surgery, such as perigastric abscesses, perigastric hematoma, rectal hematoma, perirectal biloma and perirectal abscess (4,5).

Surgery procedures usually related to the collections are intestinal reconnection, distal pancreatectomy, biliary-digestive bypass, exploratory laparotomy and bariatric surgery (6).

Pancreatic and Intraabdominal Fluid Collections

Up to 40% cases of acute pancreatitis develop collections, from which 80% are spontaneously reabsorbed, while the remaining 20% evolve into proper pseudocysts. Of these, half will be reabsorbed or stabilised, while the other half will be those with clinical relevance. Between 20 and 40% of chronic pancreatitis develop pseudocysts in the first 5 years after being diagnosed, some of which will have clinical relevance because of their evolution, size or location (7).

When the pseudocysts have clinical relevance, the most frequent symptoms, regardless of their origin, are: pain (75%), nausea (50%), low-grade fever, weight loss, palpable mass, jaundice and increased inflammatory syndrome. Some pseudocysts may complicate with obstruction of enteric, biliary or vascular transit, pseudoaneurysm, hemorrhage, infection and

rupture. When the pseudocysts are large, their spontaneous resolution is rare and their therapeutic approach becomes more difficult. In general, pseudocysts of 6 cm or less than 6 cm can be approached with conservative treatment (8). Taking the decision when to treat a pseudocyst may be complicated, since large pseudocysts diagnosed in the course of acute pancreatitis can disappear spontaneously. Classically, it was considered that a pseudocyst must be drained when it was greater than 6 cm and persisted for more than 6 weeks. Today, there is a tendency towards close monitoring and indicating treatment when the pseudocyst perpetuates symptoms, grows or becomes complicated (9). The drainage of the pseudocysts can be surgical, percutaneous or endoscopic. In the past, surgical treatment was considered the "gold standard", although it was not exempt from significant morbidity and mortality. Nowadays there is a tendency to perform minimally invasive treatments (10).

Intraabdominal abscesses can be classified according to their origin in: post-pancreatitis, post-surgical or post-traumatic. After an episode of pancreatitis, abscesses result from the liquefaction of an area of necrosis, of a peri-pancreatic collection or a pseudocyst that became infected. This happens spontaneously by bacterial translocation in up to 10% of cases, with signs of infection appearing 20-40 days after the acute episode or, more frequently, iatrogenic after inadequate intervention (11).

Postsurgical abscesses are formed by external contamination of the surgical field or, more likely, by contamination from the intestinal lumen itself during surgical manipulation. The post-traumatic ones appear after injuries of the pancreas or after traumatic pancreatitis associated with the rupture of contaminated nearby viscera. Treatment should always include adequate antibiotic therapy, although this is insufficient and mortality in pancreatic abscess is very high if it is not drained. The approaching method of the abscesses is similar to that of pseudocysts, nowadays tending towards minimally invasive techniques (12).

Endoscopic Ultrasound-guided Drainage

Endoscopic ultrasound allows description of the lesion and its distance from the gastric wall. It also allows to identify interposed vessels or structures and to describe the type of lesion and the characteristics of its contents before being punctured, in order to exclude vascular structures. The great advantage of endoscopic ultrasound is the possibility of seeing in real time, within the ultrasound plane, the material introduced into the working channel. A linear echoendoscope is used to perform these procedures.

Until a few years ago, there were available only echoendoscopes with small-gauge working channel that allowed the introduction of 7Fr double pigtail prostheses. Today there are therapeutic echoendoscopes that allow the insertion of double pigtail prostheses up to 10 Fr. When a therapeutic device is not available,

there might be another possibility: to place a guidewire inside the lesion using an echoendoscope and a puncture needle, and then to proceed the intervention with a lateral-viewing endoscope (13,14) (*Fig. 1*).

After the development of therapeutic echoendoscopes, and taking into consideration the laborious nature of the classical approach, new prosthesis placement systems have been designed in a single step procedure, such as lumen-apposing metal stents (LAMS) with electrocautery enhancement –Hot Axios – Boston Scientific or without – Axios – Boston Scientific; Nagi stent, Spaxus stent–Taewoong medical or Hanaro stent–M.I. Tech. These systems consist of a modified papillotome that allows the passage of a wire with variable hardness, a prosthesis located on the papillotome that performs the functions of introducer and a pusher or positioner catheter (15,16) (*Fig. 2*).

Figure 1. (A) - EUS view of pancreatic pseudocyst before drainage; (B) - Transgastric insertion of double pigtail 10Fr stent; (C) – Endoscopic view of the pancreatic pseudocyst content/ultrasound view after partial drainage; (D) – Endoscopic view of the final position of the stent in the stomach.

From Bucharest Clinical Emergency Hospital, Endoscopy Department

Figure 2. (A) – EUS view of WOPN; (B) – Endoscopic view of LAMS with immediate evacuation of puss from the infected collection; (C) – EUS view of the hyperechoic internal flange of LAMS; (D) – Endoscopic view of Hot Axios located intragastric/ Internal endoscopic view of the collection after drainage as seen through LAMS.

From Bucharest Clinical Emergency Hospital, Endoscopy Department

With very good results, before the development of LAMS the self-expandable fully covered metallic stents were and are still used with success in the drainage of intraabdominal fluid collections, but with a higher risk of migration than LAMS. All these devices have revolutionised the drainage of intraabdominal fluid collections (17) (*Fig. 3*).

These systems described above shorten the procedure duration by more than 80% and, in selected cases; they allow to perform the entire procedure exclusively with echoendoscopic control, avoiding the use of X-rays. The use of LAMS has emerged in the last years not only for the drainage of intraabdominal fluid collections but also for the palliation of malignant biliary-duodenal obstruction (18, 19).

Materials and Methods

The main objective of this paper is to evaluate the efficacy of EUS drainage in terms of

Figure 3. Endoscopic view of self-expandable fully covered metallic stent

technical and clinical success. Secondary objectives refer to the assessment of complete resolution of intraabdominal collection, presence of infection after drainage, overall survival.

We conducted a prospective observational study by enrolling 31 patients who were diagnosed using EUS with perigastric intra-abdominal fluid collections, from an overall of 788 EUS made over a period of 2 years—May 2016–May 2018. We analyzed their evolution during 6 months after treatment, by regular examinations (ultrasound/endoscopic/computed tomography). All of them were in-patients of Bucharest Clinical Emergency Hospital, either in Endoscopy or in Surgery Departments. Data collected was processed in IBM SPSS Statistics 20.

In 4 cases the treatment was only surgical, while the other patients were approached by: only computed-tomography-guided percutaneous drainage (1 patient), endoscopic ultrasound-guided drainage (11 patients), combined computed-tomography-guided percutaneous and EUS drainage (1 patient), combined EUS-drainage and surgical (4 patients). 10 patients were treated conservatory.

Results

Overall mean age was 51 year and intra-abdominal collections average was 109 mm (range 34 – 250 mm). Collections drained only endoscopically had an average diameter of 127 mm. Patients with collections drained firstly by EUS but eventually needed surgery due to large amount of necrosis, multiple collections or infected collections after initial drainage had a mean diameter of 166 mm. Surgery was performed when the collections had an average of 145 mm (with a range 90 – 250 mm). Collections with a mean diameter of 58 mm were successfully treated by conservatory treatment.

Most of intraabdominal collections were caused by acute pancreatitis and the drainage was performed more than 4 weeks later. 2 intraabdominal collections appeared after abdominal trauma with rupture of the

pancreatic duct, which needed extensive intra-abdominal surgery and one case appeared after duodeno-pancreatectomy for pancreatic head cancer. The low number of post-surgery collections could be explained by the fact that surgeons usually reintervene.

From the cases treated by endoscopic ultrasound-guided drainage, 6 patients underwent drainage with double pigtail plastic stent, 5 of them with good results after 4–6 weeks when the stents were removed. In one case, the patient returned 1 month after stent extraction with multiple infected collections which were approached surgically but with a bad outcome (no.1 in *Table 1*). 6 collections were drained with self-expandable fully covered metallic stents, 5 being successfully drained, but one needing eventually surgery due to transgastric migration (no.7 in *Table 1*).

Electrocautery enhanced lumen-apposing stents (Hot Axios 15/10 mm Boston Scientific) were used to treat 6 patients. On average these patients needed 3 sessions of necrosectomy until full resolution of the collection. From these patients, one patient was sent to surgery because fever appeared 2 days after stent extraction, which was accompanied by abdominal pain (no. 8 in *Table 1*). During surgery, the collection proved to be more extended than initially evaluated. One patient developed mild pneumoperitoneum after LAMS extraction, which was treated conservatory (no. 3 in *Table 1*).

Technical success rate was 100% regarding stents insertion (either plastic or metallic), while clinical success rate 83% for Hot Axios transgastric placement, 80% for both plastic and metallic stents drainage.

Overall mortality was 9,3% and was mainly related to the severity of the case, all patients had septic collections. Supplementary data should be obtained from randomized studies in order to optimize the management of these patients.

Discussions

Treatment of intraabdominal collections should be approached in a multidisciplinary way. First

Table 1. Patients table

No	Initials	Sex	Age	Collection max. diameter (mm)	Type of collection	Therapeutical approach	Type of stent used	Post-procedural evolution/complications
1	BS	F	59	140	Pancreatic pseudocyst	EUS+surgery	2x double pigtail (10Fr, 7Fr)	Death/Sepsis
2	BE	F	61	200	Pancreatic pseudocyst	EUS	fully covered metallic stent (100 x 10mm)	Full recovery
3	BM	F	50	80	WOPN	EUS	Hot Axios 15/10 mm	Full recovery/ pneumoperitoneum after Hot Axios extraction treated conservatory
4	BP	M	57	75	WOPN	EUS+CT guided percutaneous	Hot Axios 15/10 mm and 7Fr double pigtail permanent	Full recovery; disconnected pancreatic duct syndrome with EUS guided internal drainage
5	CC	M	18	156	Pancreatic injury grade 3 with perisplenic post surgery collection	EUS	fully covered metallic stent (80 x 8 mm)	Full recovery
6	CM	F	50	200	WOPN	EUS	2 x double pigtail (7Fr) and fully covered metallic stent (100 x 10 mm)	Full recovery
7	DM	F	49	190	Pancreatic pseudocyst	EUS+surgery	fully covered metallic stent (100 x 10 mm)	Fully covered metallic stent intra-collection migration, surgery with full recovery
8	FP	M	44	250	WOPN	EUS+surgery	Hot Axios 15/10 mm	Good drainage of fluid content, due to large amount of necrosis, underwent surgery with full recovery
9	IS	F	73	130	WOPN	EUS	Hot Axios 15/10 mm	Full recovery
10	MV	M	40	110	Pancreatic pseudocyst	EUS	Hot Axios 15/10 mm	Full recovery
11	MT	M	63	90	Pancreatic pseudocyst	EUS	double pigtail 10Fr	Full recovery
12	RN	M	49	87	Pancreatic pseudocyst	EUS+surgery	fully covered metallic stent (100 x 10 mm)	Good drainage of pseudocyst, due to multiple collections, underwent surgery with full recovery
13	ST	M	67	56	Pancreatic pseudocyst	EUS	double pigtail 10Fr	Full recovery
14	SP	F	66	130	WOPN	EUS	Hot Axios 15/10 mm	Full recovery
15	TM	M	49	150	Pancreatic pseudocyst	EUS	fully covered metallic stent (100 x 10 mm)	Full recovery
16	VD	M	37	100	Pancreatic injury grade 3 with post surgery collection	EUS	double pigtail 7Fr permanent	Full recovery
17	BP	M	53	250	Pancreatic pseudocyst	Surgery	No	Full recovery
18	CT	M	69	50	Pancreatic pseudocyst	Conservatory	No	Full recovery
19	CC	M	33	54	Pancreatic pseudocyst	Conservatory	No	20 mm at final follow up
20	DM	M	43	50	Pancreatic pseudocyst	Conservatory	No	Full recovery
21	DG	M	55	120	WOPN	Surgery	No	Death/Sepsis
22	DM	F	77	80	Collection after duodeno-pancreatectomy for pancreatic head cancer	CT guided percutaneous	No	Full recovery
23	MD	F	59	60	Post pancreatitis - acute collection	Conservatory	No	18 mm at final follow up
24	IM	M	36	120	Pancreatic tail non-malignant cyst	Surgery in Heidelberg, Germany	No	Full recovery
25	MC	F	51	40	Pancreatic pseudocyst	Conservatory	No	Full recovery
26	MA	M	50	150	WOPN	Conservatory	No	74 mm at final follow up
27	MM	M	30	40	Pancreatic pseudocyst	Conservatory	No	Full recovery
28	SM	F	48	34	WOPN	Conservatory	No	Full recovery
29	SA	F	56	38	WOPN	Conservatory	No	Full recovery
30	TG	M	42	90	Infected WOPN	Surgery	No	Death/Sepsis
31	TN	M	48	65	Pancreatic pseudocyst	Conservatory	No	Full recovery

of all, an adequate diagnosis must be made and the need for treatment established. The procedure should be assessed depending on the experience of each center and/or the possibility to refer the patient to a more experienced center. Using EUS guided drainage of the collection is part of the modern management and should be taken into account before surgery (which has higher morbidity and mortality rates) (20). The advantages of minimally invasive techniques are the fact the patient's recovery time will be shorter and the quality of life will increase, with overall less economic impact (21,22).

EUS allows a better characterization of the lesion, is it a pseudocyst or other type of cystic lesion that should not be drained? The differential diagnosis is broad, and includes benign cysts (<5%), cystic neoplasms of the pancreas (5-10%) and true pseudocysts (80-90%). The existence of a previous history of acute or chronic pancreatitis or an etiological antecedent that explains it, must be considered for the diagnosis (23). Generally, pseudocysts are lesions with more or less anechoic content, often with a more echogenic level on their lower side depending on detritus, necrotic tissue or hematic remains. They may contain septations and usually echogenic and regular walls, without focal thickening or vegetating projections towards its interior, without calcium in its wall and with high amylase content (24).

Using endoscopic ultrasound the nearest point of the lesion to the gastric wall can be located, this information is extremely useful when evaluating lesions that do not protrude onto the gastric wall. It also avoids confusion with other possible extrinsic impacts of the area. At the same time it allows to measure the distance between the cyst cavity or intrabdominal collection and the gastric lumen, considering that the risk of leakage into the peritoneum is reduced if the distance is equal or less than one centimeter, although this also depends on other factors such as its location or existence of inflammatory adhesions (25). Another fact that should be taken into account is the existence of submucosal vessels or true varicose veins that are not infrequently associated and that may be interposed between the gastric wall and the

cyst. The use of color Doppler helps to identify these structures and maneuver the echoendoscope in order to avoid them when it comes to puncture (26).

The high resolution images provided by the echoendoscopes allow the precise description of the content of these lesions, so that they help to decide the number and characteristics of the drainage procedures that should be performed (27).

The complications following the procedure can be classified in immediate and late. Among immediate complications are described: the perforation of the peritoneum, the puncture of another internal organ and the hemorrhage of the gastric wall or intestinal wall. These complications are rather theoretical than practical when the technique is performed adequately and under real-time endoscopic ultrasound guidance. An immediate and endoscopically unpredictable complication is intracystic hemorrhage due to sudden decompression that conditions the rupture of a pseudoaneurysm (28).

Among late complications are bleeding produced by the prosthesis on a vessel in the inferior side of the pseudocyst and also infection. The first is unpredictable and, although infrequent, it is facilitated by the reduction in size and collapse of the cavity that makes the end of the prosthesis, which was previously free inside the pseudocyst, and now rests on the contralateral wall of the pseudocyst up to the point of perforation. It is important to know that due to this risk the LAMS will be kept in place for a maximum of 3 weeks, while the plastic double pigtail stents can usually be extracted after 4-8 weeks. The infection may appear after the obstruction of the prosthesis (due to necrotic tissue) or might have already been present at the time of the procedure, case in which the treatment is that of an abscess or a collection with liquefied and infected necrosis (29,30).

To avoid the premature obstruction of the LAMS with necrotic tissue, dilation with balloon of the stent may be necessary during the procedure and an endoscopic evaluation is mandatory 1-2 days after the insertion. The collection-gastrostomy site is left to close secondarily without the need of clipping or

suturing after stent removal (31).

In order to adequately solve each case, the pattern that seems the most reasonable is:

- a) Anechoic content and leakage of crystalline fluid: a single prosthesis may be sufficient.
- b) Content with detritus or echoic signal: several prostheses $\pm$ nasocystic drainage or LAMS.
- c) Clinical signs of infection or echoic, content with gas bubbles or pus extravasation: several prostheses + nasocystic drainage or LAMS + nasocystic drainage with continuous lavage with saline solution (32).
- d) Content with solid areas or necrotic tissue with or without signs of infection: several prostheses + nasocystic drainage with continuous lavage with saline solution $\pm$ endoscopic debridement (33) or LAMS $\pm$ nasocystic drainage $\pm$ endoscopic debridement. In this case, when the content of the lesion is very thick, a 15 mm gastrocystic fistula can be made with a balloon dilator; then, the gastroscope is inserted into the cyst and with the help of a Dormiabasket the detritus can be extracted (34), in the absence of LAMS, case in which necrosectomy can be done via the lumen apposing stent.

Conclusions

We conclude that endoscopic ultrasound can be the first choice for drainage of intraabdominal perigastric fluid collections because it allows performing the entire procedure with images in real time, to characterize the lesion and its content and in most cases to also drain the collection in a single step technique. With 100 % technical success and over 80% clinical success it is safe and assures a better quality of life, when collections have an average diameter of ≤ 127 mm. For collections with a larger diameter we can expect the need of combined treatment. In addition, it may help to identify pathophysiological mechanism, to choose the appropriate point for the puncture, to measure the thickness of the wall that needs to be passed and to detect the existence of interposed vessels in order to

avoid them. Completing a 3 axes management alongside percutaneous drainage (ultrasound/CT guided) and surgery, endoscopic ultrasound guided drainage offers to our patients the opportunity of an 360° treatment.

Conflict of Interest

The authors declare no conflicts of interests.

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