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Therapeutic application of Percutaneous Peritoneovenous (Denver) Shunt in treating Chylous Ascites in Cancer patients

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Abstract

Purpose—Chylous ascites (CA) is an uncommon complication of abdominal surgeries and malignancies. The purpose of this study was to evaluate the safety and efficacy of PPVS in treating intractable CA in cancer patients.

Materials and Methods—28 patients with refractory CA treated with PPVS from April 2001 to June 2015 were reviewed. Demographic characteristics, technical success, efficacy, laboratory values and complications were recorded. Univariate and multivariate logistic regression analysis was performed.

Results—Technical success was 100% and ascites resolved or symptoms were relieved in 92.3% (26 out of 28) of patients. In 13 (46%) of these patients with urologic malignancies, whose ascites had resulted from retroperitoneal lymph node dissection ascites resolved resulting in shunt removal within 128±84 days. The shunt provided palliation of symptoms in 13 of the remaining 15 patients (87%); mean duration of 198±214 days). Serum albumin levels increased significantly (21.4%) following PPVS placement; from a pre-procedure mean of 2.98±0.64g/dl to 3.62±0.83g/dl ($p < 0.001$). Post-procedure complication rate was 37%, including shunt malfunction/occlusion (22%), venous thrombosis (7%), subclinical disseminated intravascular coagulopathy (DIC) (7%).

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Smaller venous limb size (11.5 F) and the presence of peritoneal tumor were associated with a higher rate of shunt malfunction ($p < 0.05$). No patient developed overt DIC.

Conclusion—PPVS can safely and effectively treat CA in cancer patients, resulting in significant improvement in serum albumin in addition to palliation of symptoms.

Keywords

Peritoneovenous shunt; Denver shunt; Ascites; Chylous Ascites; Cancer; Malignant ascites

Introduction

Chylous ascites (CA) in cancer patients is an uncommon but debilitating complication of abdominal surgery, described predominately following extended retroperitoneal lymph node dissection (LND) for urologic malignancies (1). The mainstay of treatment for CA is conservative management with diet modification, involving a high protein, low fat, medium-chain triglyceride oral diet or total parenteral nutrition (TPN) (1). However, considerable controversies exist regarding the effectiveness of this method. Paracentesis is performed as needed to palliate symptoms.

Peritoneovenous shunting for treatment of refractory ascites was first described by Smith in 1962. In 1974, LeVein reported his experience with a pressure sensitive unidirectional mechanical valve shunt. The shunt redistributed the ascitic fluid from the abdomen into the central circulation based on a pressure gradient between the abdomen and central venous system. In 1979, Lund and Newkirk modified this shunt by incorporating a compressible valve chamber between the peritoneal limb and the venous limb. This valve prevented reflux of fluid back into the peritoneal cavity and provided unidirectional flow. Denver® shunt (CareFusion Corporation, San Diego, CA) pump is either single-valved or double valved. The single-valve pump provides faster flow rates (30-55 ml/min). Peritoneovenous shunt placement has been primarily used for symptomatic relief in patients with intractable malignant ascites and the procedure has been described as effective and safe in this population (2). However, limited information, predominately provided by case reports and small case series, is available regarding the utilization of peritoneovenous shunt in the management of CA (1, 3-12). The purpose of this study was to evaluate the safety and efficacy of peritoneovenous shunt in cancer patients with intractable CA.

Materials and Methods

Study Design

This retrospective study was conducted under an exemption from the Institutional Review Board. Data from 28 patients with refractory CA that were treated with percutaneous peritoneovenous shunt (PPVS) placement between April 2001 and June 2015 was reviewed.

CA was defined by milky appearance of the ascites with an ascetic fluid triglyceride (TG) concentration of greater than 110 mg/dl. The peritoneal fluid was evaluated for cytology, culture and triglyceride level prior to shunt placement at the time of diagnostic/therapeutic paracentesis. Persistent or refractory CA was defined as CA that did not respond to 2 weeks

of conservative treatment and repeated paracentesis. Laboratory values recorded prior to PPVS placement (within 14 days to the procedure) included complete blood count (CBC), blood urine nitrogen, creatinine (Cr), serum albumin level, liver function tests, and coagulation profile, including prothrombin time (PT), international normalized ratio and active partial thromboplastin time. In the last two years, DIC profiles have been added to the routine pre-procedure screening laboratory tests, including fibrinogen and D-dimer levels.

Shunts were placed using the previously described technique (13). Internal jugular vein, preferably the right side was accessed. Procedure was performed under moderate sedation or Monitored Anesthesia Care. Patients received a 1st generation cephalosporin antibiotic intravenously within one hour of the procedure as prophylaxis. Prior to shunt placement, the ascites was drained close to completion, leaving only a small amount of ascites with which to prime the shunt. Ascites drainage was performed using a 12 F all-purpose drainage catheter (Cook Medical Inc., Bloomington, IN). The pigtail drainage catheter was ultimately exchanged for the peritoneal limb of the shunt. If too much ascitic fluid was drained 1 liter of warmed saline was injected into the peritoneal cavity and used to prime the shunt.

All patients were admitted. Patients were observed for signs of DIC as well as fluid overload. CBC was checked the night of the procedure, and then daily until the platelet count plateaued and/or started to rise. DIC profile was repeated daily for 3 days. Asymptomatic DIC or subclinical DIC was defined as the absence of clinical signs or symptoms of bleeding, but with abnormalities in clinical laboratory tests including: platelets $< 50 \times 10^9/l$, PT > 6 seconds above the highest normal value and fibrinogen level < 100 mg/dl. Overt DIC was defined based on the International Society for Thrombosis and Hemostasis (ISTH) guideline using ISTH scoring system (14).

Patients' high protein, low fat diet was switched to regular diet after the procedure. Patients were instructed to pump the shunt 20 times, twice a day, once in the morning and once before bedtime while in the supine position. Effective palliation was defined as improvement in at least one of the patient's symptoms and no more need for paracentesis. Complete resolution of ascites was defined as no clinical or imaging evidence of ascites while the patient was on regular diet. All patients were seen in clinic at one week and one month after shunt placement. Initial symptomatic relief was evaluated at the one week visit. Patients had follow-up cross sectional imaging every 3 months as part of their routine cancer care. All patients (except for the three performed within the last month) were followed for a minimum of 6 months. Patients were advised to contact the IR department if they experienced abdominal distention, fever, ascites leakage, or problems with pumping. Patients who noticed any changes in their pump or who had evidence of recurrent ascites were evaluated in the IR clinic. If shunt malfunction was suspected a shunt study was performed by inserting a 20 gauge Huber needle into the pump and injecting contrast. If shunt malfunction or occlusion was detected in patients with recurrent ascites, the shunt was revised. In patients with evidence of pump change with no clinical evidence of ascites, a limited abdominal ultrasound (US) or CT scan was obtained. If imaging confirmed resolution of ascites the shunt was removed. Overall shunt survival (OSS) was defined as the time from the shunt placement to removal or death from any cause. Adverse events were graded

according to the National Cancer Institute (NCI) Common Terminology Criteria for Adverse Events (CTCAE), version 4.

Statistical Analysis

Pre- and post-procedure laboratory values were compared using the Mann-Whitney *U* test. Univariate and multivariate logistic regression was performed to determine the factors that predicted complete resolution of CA and subsequent shunt removal and to determine factors associated with complications. SPSS software, version 17 (SPSS, Chicago, IL) was used for all analysis. For all statistical analyses $p < 0.05$ was considered significant.

Results

Twenty-eight patients with CA were treated with PPVS. All patients were initially treated with conservative measures for mean duration of 71 ± 65 days (range 9-313 days). Conservative management included: diet modification (32%), TPN (14%), diuretic therapy (46%), octreotide injection (7%), and repeated paracentesis (86%), used alone or in combinations. Demographic characteristic are listed in Table 1. Testicular cancer (39%) was the most common primary tumor. Surgery, particularly retroperitoneal LND (61%) was the most common etiology for the ascites. Peritoneal fluid cytology was tested in 26 out of 28 patients and was negative for malignancy in 96.2%. Cachexia (100%), abdominal distention (100%) and abdominal discomfort (71%) were the most common symptoms (Table 1). Two patients had cirrhosis with no evidence of portal hypertension (Table 1). All 28 patients had milky appearing ascites on paracentesis. Ascites TG level was not tested in 5 patients. These patients had all undergone retroperitoneal LND and CA was diagnosed based on the appearance of the fluid in conjunction with the clinical history. Mean ascites TG level was 348 mg/dl (range 21-1280 md/dl).

An average of 4.75 ± 2.05 liters (range, 1.4-9 liters) of ascites was drained at the time of the procedure. The mean amount of fluid drained during paracentesis performed prior to PPVS placement was 5.40 ± 2.27 liters (range, 2.2-9.6 liters).

PPVS was successfully placed in all patients (100% technical success). PPVS was effective in resolving ascites or providing long-term palliative treatment in 92.3% of patients. Initial symptomatic relief (abdominal distention) was achieved in 100% of the patients. Patients consisted of two different populations: 13 (46%) patients with urologic malignancies (46%), whose ascites had resulted from retroperitoneal LND and 15 patients with advanced metastatic disease with different etiologies for CA formation. CA permanently resolved in the first group allowing for shunt removal after 128 ± 84 days (range: 40-309 days). This group was followed for an average of 21.5 ± 17.3 months (range: 2.8-56 months) post-shunt removal with no evidence of recurrence of ascites. In the remaining 15 patients palliation of symptoms until removal or death was achieved in 13 (87%) patients with OSS of 198 ± 214 days (range 13-672 days). PPVS was not effective in two patients (7.7%) including: one patient with intra-abdominal mesothelioma that the peritoneal limb of the shunt occluded repeatedly and the patient was treated with repeated paracentesis and a patient with adenocarcinoma of the pancreas, status post Whipple surgery. Ascites was only temporarily

relieved and recurred despite a patent PPVS. This patient was also treated with repeated paracentesis. The mean follow up was 24.5 ± 40.8 months; (range: 0.5 – 156 months).

Figure 1 demonstrates the changes in laboratory values prior to PPVS placement and at three time points—immediately, one-week and one month post shunt placement. Serum albumin level increased by 21.4% following PPVS placement (Figure 1A). Mean albumin level prior to shunt placement was 2.98 ± 0.64 g/dl (range, 1.5-4.0 g/dl) and increased significantly to 3.62 ± 0.83 (range, 2.9-4.9) after shunt placement in the one month follow up exams (Fig. 1A; $p < 0.001$). Platelet counts decreased by 25%, 24 hours after the procedure; from a mean of $337 \times 10^9/L \pm 175 \times 10^9/L$ (range, $75-848 \times 10^9/L$) to $253 \times 10^9/L \pm 167 \times 10^9/L$ (range $21-819 \times 10^9/L$)(Fig 1B). Platelet counts generally plateaued and started rising on the 6-7th day post procedure (Fig 1 B). The fibrinogen level decreased by 12.6% 24 hours after shunt placement and plateaued in 3 days(Fig. 1 C). Serum Cr decreased by 4.8% in one month follow up evaluation.

Complications are listed in Table 2. There were no intra-procedural or immediate post-procedure complications. Eleven patients (39%) had 14 complications. Two of these complications were grade 2 and 9 were grade 3. There were no grade 4 or 5 complications. The most common complication was PPVS malfunction/occlusion (21%). One patient developed systemic infection with no evidence of infection around the PPVS. The shunt was removed and cultures were negative. Two patients (7%) developed asymptomatic or subclinical DIC (grade 2) and were observed for bleeding. No treatment was required and the condition resolved in one week in both patients. None of the patients developed overt DIC. Three patients developed SVC thrombosis, resulting in removal of shunt in one of the patients. The other two patients were treated with heparin injection and thrombosis resolved.

Subgroup analysis was performed to detect factors associated with a higher risk of complication. In the first 15 patients 11.5F venous limb size was used. In this group, 4(27%) patients developed shunt occlusion requiring revision. Therefore, 15.5F size was used in the rest of the patients and only 2(15%) patient developed shunt occlusion which was significantly lower compared to 11.5F group ($p < 0.05$). All patients with peritoneal tumor (3 patients), including those with lymphangioleiomyomatosis (LAM) and peritoneal mesothelioma developed repeated PPVS peritoneal limb occlusion.

Discussion

Despite the satisfactory reports on shunt placement, its role in treatment of CA remains controversial. In this study, Denver® shunt placement was able to successfully manage intractable CA in 26 of 28 (93%) cancer patients who had failed conservative management.

A search of the literature using MEDLINE revealed 56 reported cases of CA treated with peritoneovenous shunt (LeVeen, and Denver) placement. Results are summarized in Table 3. These reports demonstrate that PPVS is effective in treating CA in 96.4% of the patients, similar to what was found in the present study (1, 3, 11, 15-23). LeVeen *et al* reported their experience in treating ascites with LeVeen shunt in 61 patients. Ten of these patients had CA. The shunt successfully treated 9 out of 10 patients (90%) (19). Evans *et al* reported their

experience in treating 5 patients with testicular cancer who underwent post-chemotherapy retroperitoneal LND complicated by CA treated with Denver shunt (1). In their study, only 23% of the patients with CA required Denver shunt placement and the shunt was effective in treating all 5 patients (1).

In the present study, the shunt was removed in 13 patients after documenting resolution of ascites. These patients were predominately young males with testicular cancer whom had undergone retroperitoneal LND. Since PPVS has been used mostly in patients with chronic diseases including cirrhosis and malignancy there is little information regarding when to remove the shunt. In the present study, the shunts were removed after a mean duration of 4 months without recurrence (mean, 117 ± 59 days; range, 55-253). Sooriakumaran *et al* retrospectively reviewed 11 children with intractable ascites and removed 5 shunts in 1-3 years post placement without recurrence of ascites (24). Based on this, they recommended elective removal of the shunts after 1 year. Matsufuji *et al* reported removing a shunt in a pediatric patient with CA after 3 years (25). They first ligated the infusion catheter and observed the patient for 2 weeks to confirm permanent resolution of ascites (25). In adults there are two case reports by Sarazin *et al* and Fleischer *et al* in which shunts were removed after 25 days and 24 months, respectively (3, 4). Based on the results of the present study, the recommendation is that when a patient experiences changes in pump consistency and there is no clinical or radiographic evidence of ascites then the shunt can be removed. This was possible after 4 months. Removal of the shunt is recommended in such patients to avoid the continued presence of a foreign body that can lead to venous occlusion and/or thrombosis.

Reported complications of PPVS include shunt occlusion, gastrointestinal tract (variceal) bleeding, infection, and DIC (26). The incidence of clinical or overt DIC has been reported to be as high as 35%, predominately in the early reports (26). One of the proposed reasons for development of DIC is rapid introduction of the ascitic fluid containing high levels of fibrin-rich pro-coagulants, including endotoxin, thromboplastin activated clotting factors and plasminogen activator into the central venous system. These pro-coagulant factors ultimately activate the coagulation pathways (27). The reason for increase in fibrin-rich pro-coagulants in the ascites fluid in malignant ascites is increased vascular permeability due to inflammation and increased levels of vascular endothelial growth factors. However, in CA the main reason for ascites formation is leakage of chyle due to the obstruction or disruption of the lymphatic system. Therefore, returning the chylous fluid back into the circulation is actually physiologic, though in shunt patients, the fluid is returning through an artificial conduit. Makino *et al*, twice infused 1000 ml of CA intravenously after paracentesis in a patient with CA and observed no coagulation abnormality (28). Additionally, in none of the 56 patients reported in the literature has DIC been observed (Table 3). In the present study, no overt DIC was detected. The platelet level decreased by 25%, twenty-four hours after the procedure and the mean fibrinogen level decreased by 12.6% without fulfilling the diagnostic criteria for DIC after shunt placement. Recently authors suggest limiting the risk of DIC by draining the ascites to completion at the time of shunt placement, and replacing the ascites with 4 liters of normal saline, in order to avoid putting into circulation a large amount of potentially DIC-inducing substances which might be in the ascites. (13, 29). In the present study, the majority of ascites fluid was drained at the time of the procedure.

The most common complication observed in the present study was catheter occlusion (39%). This is similar to prior reports (21, 30-33). Four out of 15 patients (27%) in whom an 11.5F venous limb device was placed developed shunt malfunction due to occlusion of the venous limb. These patients all did well after the PPVS was replaced with 15.5F venous limb. As a result, in the last 13 patients only the 15.5F venous limb was used and that has become the standard. Peritoneal disease, including Lymphangioleiomyomatosis (LAM) and peritoneal mesothelioma was also associated with higher incidence of occlusion. This is similar to previous case reports in which the shunt occluded in three out of four patients (75%) with LAM (21, 28, 32, 33). Therefore, when counseling patients with LAM, they should be advised that they are at increased risk for shunt malfunction.

Management of CA is challenging and this disorder is debilitating for the patients. Two thirds of these patients respond to conservative treatment consisting of dietary restriction in the form of a high-protein, low-fat diet with medium chain triglyceride (MCT) supplementation or TPN (11, 15, 34). Somatostatin analogs may also be useful. One of the main problems with conservative management and paracentesis is loss of nutrients and the risk of developing malnutrition. In the present study, the serum albumin level increased significantly following PPVS placement. The albumin level increased after PPVS by 21.4%, from 2.98 ± 0.64 g/dl to 3.62 ± 0.83 g/dl ($p < 0.001$). Unfortunately, we do not have any quantitative quality of life data to support documented patient reports of improved muscle mass and well-being associated with a return to normal diet and improved nutrition.

One of the limitations of this study is the retrospective design. Second limitation is that the study population is made of two very different group ages. The first group is young male patients with CA resulting from retroperitoneal LND. These patients have good medical health status with few or no comorbidities and the second group is more elderly population with comorbidities. Although, effort has been made to separate the data as much as possible however, the data of these two groups has been combined at times and that may bias the results.

The present study demonstrates that PVS is an effective and safe therapeutic option for the management of CA without risk of DIC. PPVS should be considered early in the patient's course in the face of intractable CA. Chylous ascites resulting from retroperitoneal lymph node dissection may resolve permanently, allowing removal of the shunt.

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Figure 1.

A-D. Laboratory values. 1A. Demonstrating changes in the Albumin levels at three different timings: Preop = in the 3 weeks times prior to the procedure; Post op immed = at the 1 week follow up and post op latest = at one month follow up evaluation. Figure 1B. Demonstrates the changes in platelet counts: Preop = in the 48 hours prior to the procedure; Postop 12 hrs = at the night of the procedure; Post Op 24 hrs = counts the next morning after the procedure; Post Op 48 hrs = counts 2 days after the procedure; Post Op 72 hrs = 3 days after

the procedure; Post Op Discharge = at one week follow up; Post op Latest = at one month follow up. 1C. Fibrinogen level and 6 different period of time; PreOp: In the same day, prior to the procedure; Immed Post: Fibrinogen values at the night of the procedure, At 24 hrs = counts the next morning after the procedure; At 36 hrs = counts the next night after the procedure; At 48 hrs = 2 days after the procedure, Latest = at one month post procedure. Figure 1 D. Prothrombin level at three periods of time: PreOp: on the day of the procedure, prior to the procedure, Post Op Immed = at the night of the procedure and Post Op Latest = one month after the procedure in follow up clinic visit.

Table 1
Demographic characteristics of the total 28 patients

Demographic Characteristics	Number of patients (%)
Age (yr)	
Mean	50 ± 16.6
Median	46
Range	23-80
Sex	
F	11 (39)
M	17 (61)
Type of Cancer	
Testicular	11 (39)
Breast	3 (10.7)
Pancreatic	3 (10.7)
Bladder	2 (7.2)
Lymphangioleiomyomatosis	2 (7.2)
Peritoneal (Intestinal) mesothelioma	1 (3.6)
Sarcoma	1 (3.6)
Lymphoma	1 (3.6)
Leukemia	1 (3.6)
Esophageal	1 (3.6)
Colorectal	1 (3.6)
Adenocarcinoma of unknown origin	1 (3.6)
Cytology	
Malignant	1 (3.8)
Nonmalignant	25 (96.2)
Not performed	2 (7.2)
Etiology	
Surgery (LN dissection)	17 (61)
Cancer related	11 (39)
Symptoms	
Abdominal Distention	28 (100)
Cachexia	28 (100)
Abdominal discomfort/pain	20 (71)
Anorexia	11 (39)
Nausea/Vomiting	3 (11)
Co-morbidities	
None	13 (46.4)
Hypertension	8 (28.5)
Coronary artery disease	3 (10.7)
Heart failure	2 (7.2)
Diabetes mellitus	4 (14)

Demographic Characteristics	Number of patients (%)
Cirrhosis	2 (7.2)
Liver failure	0 (0)
Nephrectomy	6 (21)
Renal failure	0 (0)
History of DVT	4 (14)
Morbid obesity	1 (3.6)

LN = Lymph node

DVT = Deep vein thrombosis

Table 2
Post procedure complications

Complications	Number (%)	CTCAE* grading
Malfunction/occlusion Venous/Peritoneal limb occlusion	6 (21.4)	3
SVC thrombosis +/- PE	2 (7)	3
Non symptomatic/subclinical DIC	2 (7)	2
Systemic infection	1 (3.6)	3
Catheter infection	0 (0)	n/a
Overt DIC	0 (0)	n/a
Total	11 (39)	

* Common Terminology Criteria for Adverse Events, v 4.0

SVC = Superior vena cava

PE = Pulmonary embolism

Table 3

Review of the literature on Chylous ascites treated with PPVS.

Author	Year	Study design	# pt	Etiology	Efficacy	Complication rate	Adverse Event	Shunt survival	Shunt used
LeVeen (19)	1976	Retro	10	3 spontaneous 2 pediatric 5 distal spleno-renal shunt	90%	58%	1 died 1 peritonitis	No info	LeVeen
Miedema (20)	1978	Case report	2	Retropertitoneal LND	50%	0%	None	No info	LeVeen
Chang (21)	1980	Case report	1	Lymphangiomatosis	100%	100%	Occluded	6 m	Denver
Ryan (30)	1981	Case report	1	Retropertitoneal cystic hygroma	100%	100%	Occluded	24 m	No info
Gutmann (31)	1982	Case report	2	Congenital/Pediatrics	100%	100%	Occluded	10 days 1 m	LeVeen
Turner (23)	1983	Case report	1	Post Warren shunt	100%	0%	None	7 m	Denver
Selli (35)	1984	Case report	1	Retropertitoneal LND	100%	0%	None	6 m	Denver
Man (16)	1985	Case Series	4	Pediatric	75%	0%	None	2.5-48m	Raimondi LeVeen
Kerr (36)	1985	Case report	1	No info	No info	No info	No info	No info	No info
Sarazin (3)	1986	Case report	1	Abdominal aorta repair	100%	0%	None	Ascites resolved and shunt removed after 2.5 d	LeVeen
Savlov (37)	1987	Case report	1	Seminoma, Retroperitoneal LND	100%	100%	GI bleed	1 m	Denver
Fleischer (4)	1987	Case report	1	Post AAA repair	100%	0%	None	Ascites resolved and shunt removed after 24m	Denver
Boyd (5)	1989	Case report	1	Post AAA repair	100%	0%	None	No info	No info
Ablan (9)	1990	Case report	1	Mesocaval shunt	100%	0%	None	No info	No info
Ohri (18)	1990	Case report	1	Post duodenectomy	100%	0%	None	No info	LeVeen
Silk (17)	1991	Case report	1	Post retroperitoneal surgery	100%	No info	No info	No info	No info
Sanger (6)	1991	Case report	1	Post AAA repair	100%	100%	Septicemia/Shunt infection	4.5 m	LeVeen
Williams (7)	1991	Case report	1	Post AAA repair	100%	0%	None	No info	Denver
Pbst (22)	1993	Case series	5	Post Aortic surgery	80%	20%	Sepsis	No info	Denver
Voros (10)	1995	Case report	1	Post Splenorenal shunt	100%	0%	None	4 years	LeVeen
Kaas (15)	2001	Retro	3	Retropertitoneal LND	100%	30%	Sepsis	1 sepsis	Denver
Manolitsas (38)	2002	Case report	2	Post radiation	100%	0%	None	20 m post 8 m post	Denver shunt
Campisi (39)	2006	Retro	1	Primary chylous ascites	100%	0%	None	No info	LeVeen

Author	Year	Study design	# pt	Etiology	Efficacy	Complication rate	Adverse Event	Shunt survival	Shunt used
Evans (1)	2006	Retro	5	Testicular; Retroperitoneal LND	100%	100%	1 peritonitis 1 sepsis 4 revised	No info	No info
Matsufuji (25)	2006	Case report	1	Neuroblastoma; Retroperitoneal LND	100%	0%	None	Ascites resolved and shunt removed after 30m	Denver
Lefrou (32)	2006	Case report	1	LAM	100%	100%	Occluded	3 years	LeVeen
Malik (11)	2007	Retro	1	Post pancreas surgery	100%	No info	No info	No info	No info
Makino (28)	2008	Case report	1	LAM	100%	0%	None	12 m	Denver
Assumpcao (8)	2008	Retro	2	Post pancreas Ca surgery	100%	No info	No info	No info	No info
Kanou (33)	2012	Case report	1	LAM	100%	100%	Occluded	12 m	Denver shunt
Total			56		96.4%	35%			

No info = No information

AAA = Abdominal aortic aneurysm

RLND = Retroperitoneal lymph node dissection