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# Laparoscopic Revision of the Distally Obstructed Ventriculoperitoneal Shunt

## *Distal Obstrüksiyonlu Ventriküloperitoneal Şantın Laparoskopik Revizyonu*

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### ABSTRACT

**AIM:** Evaluation of the laparoscopic assisted revision of the ventriculoperitoneal shunt as an alternative technique to the traditional laparotomy.

**MATERIAL and METHODS:** Out of 1181 elective neurosurgical procedures have been done from January 2009 to December 2010. There are 98 (8.2%) ventriculoperitoneal shunt procedures. New shunt insertion was performed 41 times (41.9%) and shunt revision performed 57 times (58.1%). Shunt-related infection was detected in 11 cases (11.22%) while mechanical failure was found in 46 cases (46.9%), proximal obstruction was diagnosed in 26 cases (26.5 %) while 20 patients (20.4%) suffered from distal obstruction. Out of the 20 patients with distal obstruction, 12 patients were treated with laparoscopic assisted revision of the peritoneal end.

**RESULTS:** Intra operative finding revealed peritoneal adhesion in 83.3% of cases and cerebrospinal fluid pseudo cyst in 16.6% while extra peritoneal tube was found in one case. Intraoperative management included adhesiolysis in 10 patient, evacuation and marsupialization of the cyst in two cases in addition to tube repositioning in all cases. There was no procedure-related complications.

**CONCLUSION:** Laparoscopic assisted revision of the peritoneal catheter is an alternative technique to traditional laparotomy in the revision of ventriculoperitoneal shunt.

**KEYWORDS:** Hydrocephalus, Ventriculoperitoneal shunt, Laparoscope

### ÖZ

**AMAÇ:** Geleneksel laparotomiye alternatif bir teknik olarak ventriküloperitoneal şantın laparoskopik yardımcı revizyonunun değerlendirilmesi.

**YÖNTEM ve GEREÇLER:** Ocak 2009 ile Aralık 2010 arasında 1181 elektif nörocerrahi işlem gerçekleştirildi. 98 (%8,2) ventriküloperitoneal şant işlemi vardı. Yeni şant işlemi 41 kez (%41,9) ve şant revizyonu 57 kez (%58,1) yapıldı. Şantla ilgili enfeksiyon 11 vakada (%11,22), mekanik başarısızlık 46 vakada (%46,9), proksimal obstrüksiyon 26 vakada (%26,5) ve distal obstrüksiyon 20 vakada (%20,4) bulundu. Distal obstrüksiyon bulunan 20 hasta içinde 12 hasta laparoskopik yardımcıyla peritoneal ucun revizyonuyla tedavi edildi.

**BULGULAR:** İntraoperatif bulgular vakaların %83,3'ünde peritoneal adezyon ve %16,6'sında serebrospinal sıvı psödokisti gösterirken bir vakada bir ekstraperitoneal tüp saptandı. İntraoperatif takip 10 hastada adezyoliz, iki vakada kist boşaltılması ve marsupiyalizasyonu ve ayrıca tüm vakalarda tüpün tekrar konumlandırılması yapıldı. İşlemle ilgili bir komplikasyon olmadı.

**SONUÇ:** Peritoneal kateterin laparoskopik yardımcı revizyonu ventriküloperitoneal şant revizyonunda geleneksel laparotomiye alternatif bir tekniktir.

**ANAHTAR SÖZCÜKLER:** Hidrosefali, Ventriküloperitoneal şant, Laparoskop

### INTRODUCTION

Ventriculoperitoneal shunt (VPS) is a common neurosurgical procedure and considered the most commonly accepted treatment for hydrocephalus (2,7,14,17,29,30,31,32), however it can be considered one of the most common neurosurgical procedures associated with complications (3,10). Those complications include mechanical failure, infection, and disconnection or fractured segment with or without migration of the shunt tube (3, 10, 14, 29, 32).

Mechanical failure of the VPS may be due to obstruction of the ventricular end, peritoneal end or malfunction of the valve

itself. Proximal obstruction of the shunt system is the main cause of mechanical failure which can be caused by plugging of the ventricular catheter by brain parenchyma, portentous material or choroid plexus while distal obstruction of VPS represents 25% to 30% of cases with mechanical failure (12). The most common causes of peritoneal catheter obstruction is peritoneal adhesion, cerebrospinal fluid pseudo cyst, tubal kinking and tubal migration and rarely false insertion of the tube (12, 14, 17, 25).

Radioisotope scan can diagnose the site of obstruction (6) but shunt failure can be diagnosed by using CT brain to evaluate

the ventricular size while disconnected tube or migrated one can be diagnosed by only X-ray.

Cerebrospinal fluid pseudo cyst is an uncommon complication but it is considered a significant cause of distal shunt obstruction (23) and may reach a large size or lead to intestinal obstruction. Cerebrospinal fluid pseudo cyst can be diagnosed by ultrasonography or CT abdomen. Although the ultrasound is considered the main diagnostic tool to diagnose the cerebrospinal fluid pseudo cyst, there are still missed cases especially in case of small cysts.

Laparoscopic assisted shunting procedures are considered an alternative to the traditional laparotomy technique to insert the distal catheter and may improve the outcome of shunting procedures by accurate evaluation and management of the distal end of peritoneal catheter especially in patients with previous revisions, abdominal adhesions or cerebrospinal fluid pseudocysts (7,9,14,17,20,24,31).

**PATIENTS and METHODS**

Out of 1181 elective neurosurgical procedures that have been performed from January 2009 to December 2010, there were 98 (8.2%) ventriculoperitoneal shunt procedures. New shunt insertion was performed 41 times (41.9%) and shunt revision performed 57 times (58.1%).

All patients had a history of ventriculoperitoneal shunt insertion and presented with clinical manifestations of shunt obstruction and clinical evaluation of the shunt system revealed distal resistance with manual valve compression and CT brain revealed dilated ventricles. For all patients X-ray was done to exclude the disconnected system while abdominal ultrasonography was done to diagnose any possible cause of obstruction.

Three patients in this study exposed to one previous revision and one patients was exposed to two previous revisions while the rest of patients has no history of previous revision.

Laparoscopic procedure planned for releasing distal tip of the shunt entrapped in peritoneal adhesions, and for performing adhesiolysis and repositioning of the shunt tube and in cases associated with pseudo cyst we planned to open the cysts with their drainage and marsupialization of the wall (Figures 1-6). The procedure starts with supra umbilical small incision for creation of pneumoperitoneum (pressure of 14 mm Hg in adult sand 8 mm Hg in pediatric patients) by the use of a Verrus needle (closed technique) or by the open method in cases with previous abdominal surgery in which intraabdominal adhesions can be found. Laparoscopic exploration of the abdomen to detect site of the collections that will be drained with freeing of the intraperitoneal adhesions between the liver, diaphragm and abdominal viscera, followed by peritoneal flush with normal saline for peritoneal toilet. Finally, repositioning of the shunt to the pelvis or left hypochondrium after ensuring its patency seeing CSF dribbling from its distal end. Three patients in our study needed proximal revision in the same sitting as there was no accepted CSF flow from the tube.

**RESULTS**

This study included 12 patients with distal VP shunt obstruction. There were 7 females and 5 males aged between 6 and 41 years with a mean age of 19.58±9.9 years. The mean period of follow up was 8.58 ±3.14 months.

The overall shunt related-infection rate was 11/98 cases (11.22%) while mechanical failure was found in 46 cases (46.9%), proximal obstruction was diagnosed in 26 cases (26.5 %) and 20 patients (20.4%) suffered from distal obstruction as shown in Table I.

Out of the 20 patients with distal obstruction 12 patients were treated with laparoscopic assisted revision of the peritoneal end. Intra operative findings revealed peritoneal adhesion in 83.3% of cases and cerebrospinal fluid pseudo cyst in 16.6% while an extra peritoneal tube was found in one case but in two patients we found a CSF pseudo cyst as shown in Table II. Intraoperative management included adhesiolysis in 10 patients, evacuation and marsupialization of the cyst in two cases, in addition to tube reposition in all cases as shown in Table III.

**DISCUSSION**

Cerebrospinal fluid (CSF) diversion procedures are a common daily task for neurosurgeons and it is still the most common modality of treatment for hydrocephalus in spite of reported and known complications of ventriculo-peritoneal shunt (VPS) (2,7,14,17,24,25,29,30,31,32).

In our study, cerebrospinal fluid diversion represented 9.65% of our work and 85.6% of them were ventriculoperitoneal shunts (VPS), whether insertion or revisions, representing 8.2% of the neurosurgical procedures which is higher than the reported cases in the study of Korinek et al. (29) who reported 839 shunt surgeries out of 14275 patients who underwent neurosurgical procedures, representing 5.87% of their cases.

Total shunt revision in our series represented 58.1% of shunt procedures which is much higher than the result of Naftel et

**Table I:** Ventriculoperitoneal Shunt Related Complications

Cause of revision	N	%
<b>infection</b>	11	11.22%
<b>Distal obstruction</b>	20	20.4%
<b>Proximal obstruction</b>	26	26.6%
<b>Total</b>	57	58.1%

**Table II:** Causes of Distal Obstruction

Intaoperative finding	Number of cases	Percentage
<b>peritoneal adhesions</b>	10	83.3%
<b>cerebrospinal fluid pseudo cyst</b>	2	16.6%
<b>Extra peritoneal tube</b>	1	8.3%



**Figure 1:** Initial intraperitoneal view showing peritoneal adhesions around the tube.



**Figure 2:** Intraperitoneal pseudocyst.



**Figure 3:** The distal end of VP shunt inside the cyst.



**Figure 4:** Early adhesiolysis.



**Figure 5:** Removal of the distal end, evacuation of the cyst with final adhesiolysis.



**Figure 6:** Repositioning of the tube.

al. (20) and Korinek et al. (15) who demonstrated that a failure and shunt revision rate of 20% and 23.3% respectively while in the study of Martin et al. (17) shunt failure was 58.8% which is parallel to our study.

Shunt-related infections represent 2 to 27% of total shunt procedures (8, 15, 18, 21, 22, 28, 27, 30). Shunt revision due to shunt related infection in our study represented 11.22% of the total cases which is slightly higher than the result of Kulkarni et al. (26) who reported 10% infection rate after VPS insertion but less than the results of Kinasha et al. (13) who

reported 24.6% shunt related infection but overall in our elective neurosurgical procedures the incidence of shunt related infection is still accepted.

Mechanical failure after shunt insertion was found in 10%-70% of cases in different studies (1,12,19,23,29) and in our study mechanical failure was found in 46.9% of the shunt procedures. This finding is parallel to some series and not other series. This difference can be attributed to the difference in the follow up period, the type of the system and the age of the patients in each study.

**Table III:** Cases of Laparoscopic Assisted Shunt Revision

cases	Age& sex	Intraoperative finding	Management	Follow up	Previous revision	outcome
1	14/f	adhesion	Adhesiolysis tube reposition	6	one previous revision	good
2	22/f	adhesion	Adhesiolysis tube reposition	8	No previous revision	good
3	41/m	Extraperitoneal tube	Intra peritoneal insertion	14	No previous revision	good
4	18/m	adhesion	Adhesiolysis tube reposition	7	No previous revision	good
5	17/f	adhesion	Adhesiolysis tube reposition	9	No previous revision	fair
6	9/f	adhesion	Adhesiolysis tube reposition proximal revision	15	two previous revision	died
7	25/f	Adhesion cyst	Marsupilization and evacuation of the cyst tube reposition adhesiolysis	6	One previous revision	good
8	16/m	adhesion	Adhesiolysis tube reposition	11	No previous revision	good
9	22/f	Adhesion cyst	Marsupilization and evacuation of the cyst tube reposition adhesiolysis	8	No previous revision	good
10	33/m	adhesion	Adhesiolysis tube reposition proximal revision	6	No previous revision	good
11	6/m	adhesion	Adhesiolysis tube reposition	6	No previous revision	good
12	12/f	adhesion	Adhesiolysis tube reposition proximal revision	7	No previous revision	fair

In our series, preoperative assessment of the cases with malfunction shunt due to mechanical failure revealed that 20 patients (43.47%) suffered from distal obstruction while proximal obstruction was found in 26 cases (56.53 %). These findings revealed a higher failure rate due to distal obstruction than the reported results which ranged between 20% to 30% of all mechanical failures (1, 5, 11, 19).

Distal mechanical malfunctions of VPS include preperitoneal placing of the distal end, malabsorption secondary to intra-abdominal adhesions or CSF pseudocysts formation (1, 19). In our series the main cause of distal mechanical failure was peritoneal adhesion as it was found in most of cases while cyst formation was found in 2 cases and extraperitoneal tube was detected in one case.

For a long time in our institute we have been following the standard technique to insert the peritoneal catheter which

requires minilaparotomy with abdominal incision and muscle dissection to reach our target, which is the intra peritoneal space (7,9,20). During shunt revisions we usually make revision for the peritoneal end by externalizing the tube and checking for CSF flow which are considered diagnostic and therapeutic procedures and only do cranial revision if there is no CSF flow from the peritoneal end to avoid the unneeded exposure of the reservoir or the brain and decrease the related complications. This slandered technique is associated with multiple complications especially in the shunt revision which is associated with a higher incidence of infection and abdominal adhesion and may lead to visceral injury and sometimes the tube may be broken during extraction so we started to use the laparoscope in some cases of distal tube revision due to the suspected benefit as reduction of the abdominal trauma and decrease of the peritoneal adhesions (7,9,14,17,20,24).



In our study, intraoperative findings revealed intra-abdominal adhesions in 10 cases (83.3%) which is a very significant finding as the adhesion can be diagnosed by laparoscope and cannot be diagnosed by mini laparotomy in the traditional revision which can explain the repeated mechanical failure in distally revised shunt. In these cases, incomplete adhesiolysis is performed and repositioning of the tube has been done into another place according to the laparoscopic finding but unfortunately 3/10 cases needed distal revision within one month with poor prognosis in two of them who suffered intermittent manifestation of shunt malfunction which was attributed to decreased absorptive power of the peritoneum and needed insertion of another VPS. The second patient did not improve and needed ventriculoatrial shunt while the third patient died during the follow up after repeated hospital admission and repeated proximal and distal revision.

CSF pseudo cyst is rare complication but it is a very significant cause of shunt obstruction which may be presented by signs of shunt malfunction or with abdominal pain or abdominal mass (23). In our series CSF pseudo cyst was found in 2 cases representing 16.6% of the operated cases while it represented 10% of all distal obstruction shunts and 4.8 % of all cases with mechanical failure. These results are similar to the results of Rainov et al. (23) who reported that pseudo cyst formation causes shunt obstruction in 4.5% of cases mechanical failure.

Laparoscopic evacuation, and marsupialization of the cyst with tube reposition in these cases gives a good result with a smooth postoperative course. In our study, an extra peritoneal tube was found in one case (8.3%) which cannot be explained if it was extra peritoneal from the start or the tube migrated outside the perineum after initial accurate insertion. In this case reinsertion of the tube into the peritoneal space led to good shunt function.

The postoperative course showed various outcomes according to the intraoperative finding as in cases with pseudo cyst and extra peritoneal tube the course was good without any manifestation of shunt malfunction but in cases of adhesion the postoperative course was fair as there was intermittent headache with manifestation of shunt malfunction in three cases that needed another shunt revision and insertion of new shunt and one of them needed insertion of a ventriculoatrial shunt later.

In summary; Laparoscopic assisted shunt revision is a suitable alternative to the traditional minilaparotomy in cases with obstructed shunt because it helps in the diagnosis and management of the cause of obstruction and accurate peritoneal placement of the tube under direct vision.

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