University of Nebraska Medical Center
Nebraska Medicine

Graduate Medical Education Research Journal

Volume 4 | Issue 1 Article 8

July 2022

Introducer-free MIS-assisted Ventriculoperitoneal Shunt Placement: A Technical Document

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Abstract

Background

The placement of the distal catheter of a ventriculoperitoneal shunt (VPS) can be challenging in patients with a large body habitus. Given the complications associated with ventriculoperitoneal shunts and known infection risk of obese patients, new techniques for VPS placement that bypass the abdominal fat must be sought. By avoiding the abdominal fat, decreased complications and infection risk may be possible.

Objective

The objective of this technical document is to describe a laparoscopic approach to the abdominal cavity during ventriculoperitoneal shunt surgery that makes use of a direct tunneling technique into the peritoneal space.

Methods

We perform a ventriculoperitoneal shunt placement with distal catheter implantation under laparoscopic guidance. Tunneling of the distal abdominal catheter was done through the abdominal fascia directly, without creation of a stab incision for the insertion site. Intraoperative video media was obtained using video footage from OPTIVIEW camera.

Results

We have found this technique to be feasible and useful for patients with large body habitus. By eliminating the incision overlying the catheter there is decreased risk for infection by skin flora and overall decreased risk of complications.

Conclusion

Our technique of tunneling directly into the abdominal cavity is both novel and feasible. To our knowledge this is the first time this technique has been described. We believe that further study of this technique in a case series may highlight its advantages in a certain subpopulation of patients requiring VPS.

Keywords

Ventriculoperitoneal shunt; Surgical site Infection; Obesity

Authors

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Introducer-Free Mis-Assisted Ventriculoperitoneal Shunt Placement: A Technical Document

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https://doi.org/10.32873/unmc.dc.gmerj.4.1.005

Abstract

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Introduction

Ventriculoperitoneal shunt (VPS) placement, the most common treatment modality for hydrocephalus, is a common neurosurgical procedure.[1] While it is a common procedure, it can be a significant source of complications for the patient. Merkler et al determined that over 20% of patients with a VPS had a complication in their study follow-up period and over 20% needed revision.[2] The two most common causes of shunt complication in these patients are obstruction and infection.[3] The obese patient population has an increased risk of surgical infections, leading us to propose a new technique for distal catheter placement of the VPS.[4]

Distal complications of the VPS catheter include infection and obstruction. Infection is often caused by the skin flora *Staphylococcus epidermidis and Staphylococcus aureus*.[5] Obstruction of the catheter may be due to abdominal hernias occurring secondary to an incision, formation of a pseudocyst, or migration of the distal catheter.[6-9] In patients with a large body habitus, wound healing is of concern because increased adipose tissue impedes perfusion and predisposes patients to greater incidences of ischemia and suboptimal immune responses involved in tissue repair.[10,11]

The known complications of VPS placement and the added intricacy of the at-risk obese patient brings into consideration additional challenges for the surgeon. Traditionally, placement of a VPS can be completed via a minimally invasive technique or open abdominal technique.[12-14] At our institution, we have a novel technique that is completed with a direct approach and is particularly helpful in patients with an increased depth of tissue from skin to the peritoneum. The approach avoids a skin incision overlying the catheter and negates the use of the pull-away introducer trocar. Patients with a large body habitus have an increased subcutaneous tissue depth which has been associated with increased risk of surgical site infections.[15]

Given this knowledge that obese patients have increased risk of surgical infections, we aimed to develop this new technique to avoid incisions overlying the distal catheter. By negating this overlying incision, we believe this can help decrease the risk of complications. The open abdominal incision would place the patient at risk for wound infection, catheter pull out, and abdominal wall hernia.[16] Ultimately, we propose the use of this direct approach technique in obese patients due to the increased likelihood of complications.

As we learned through institutional experience, and literature review, obesity is associated with increased infection rates and complications. Key advancements are warranted to reduce complications, necessitating novel approaches to allow optimal apparatus placement. The approach outlined in this document aims to mitigate infection and post-operative complications in at-risk obese patients. The objective of this technical document is to describe a laparoscopic approach to the abdominal cavity during ventriculoperitoneal shunt surgery that makes use of a direct tunneling technique into the peritoneal space.

Case

Prior to surgery, we obtained informed consent for the procedure and for the use of video and photographic media for the purposes of creating an instructional video. In the operating room, the patient was positioned supine with the neck slightly extended and rotated away (to the left) from the surgical site. The entry site for the planned burr hole was marked approximately 3cm superior and posterior to the patient's right pinna. A U-shaped incision with inferior facing skin pedicle was made around the expected burr hole site. The galea was elevated with care to preserve the pericranium and Metzenbaum scissors were used to create a pocket inferiorly for the shunt valve to rest.

We used a non-disposable tunneling passer with a disposable sheath tunnel in the cranial to caudal direction, starting at the inferior aspect of the subgaleal pocket to the patient's abdomen superficial to the fascia and ending inferior to the patient's diaphragm. At this point, the laparoscopic surgeon placed a 5mm trocar with OPTIVIEW camera into the left upper quadrant of the abdomen and insufflated to 12-15 mmHg pressure. Slightly higher pressure may be required for patients with obese body habitus, and care should be made to monitor the patient's venous blood return during this process. Two additional OPTIVIEW trocars were then placed under direct vision (Figure 1). No additional stab incision was made at the entry point of the abdominal catheter. The initial positioning of the laparoscopic trocars allowed the camera (left lower quadrant) to view the docking procedure of the tunneling sheath (right

upper quadrant) with the suction (right lower quadrant).

As described [Supplemental Video 1], the tunneling device was removed under direct vision, leaving the distal end of the plastic sheath in the peritoneal cavity. The distal end of the tunneling sheath was connected to one of the 5mm trocars and placed under suction as the distal shunt catheter was fed into the sheath using the bucket-and-straw technique.[17] Once the distal end of the catheter was visualized in the peritoneal cavity, two graspers were used to pull the catheter into the abdomen as the sheath was removed (Figure 2). The use of both graspers in a pin-and-pull fashion is the most secure way to introduce the shunt tubing into the peritoneal cavity. Due to some elasticity in the Bactoseal catheter, one grasper was used to always hold on to the catheter while the tunneling sheath was removed so as not to unintentionally pull the catheter out of the peritoneal cavity (Figure 3).

Once an adequate length of catheter was visualized in the peritoneal cavity (Figure 4), the cranial end of the catheter was then connected to the shunt valve. The pericranium was then reflected inferiorly with monopolar cautery to expose bone, a burr hole was created, and the ventricular shunt catheter was inserted using neuro-navigation to the appropriate location. Once CSF outflow was noted from the ventricular catheter, it was connected to the shunt valve. Both ends of the valve were secured to the catheters with 2-0 silk ties. CSF flow was then observed in the abdominal portion of the catheter under direct visualization. At this point the abdominal trocars were removed and all abdominal and cranial wound sites were closed.

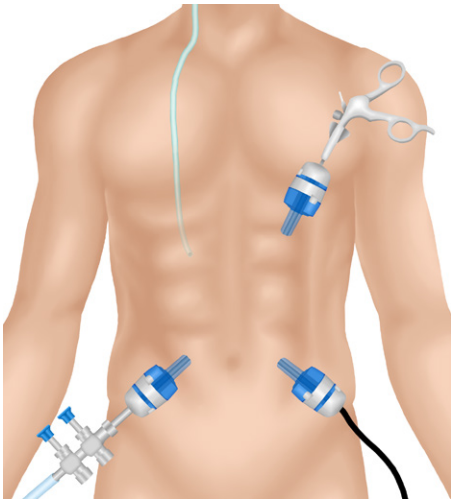

Figure 1. The initial positioning of the laparoscopic trocars allows the camera (left lower quadrant) to view the docking procedure of the tunneling sheath (right upper quadrant) with the suction (right lower quadrant).

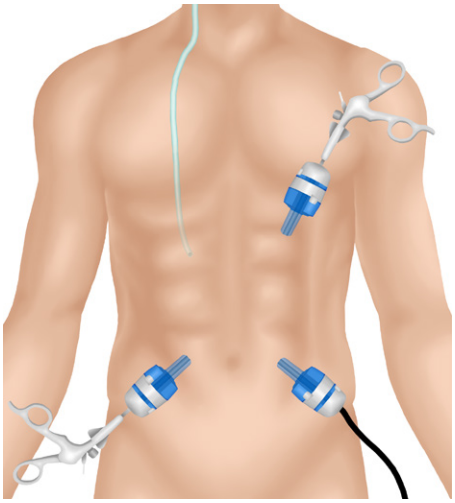

Figure 2. Once the shunt tubing has been moved through the tunneling sheath with aid of suction, the suction is replaced by a grasper (right lower quadrant). The use of both graspers in a pin-and-pull fashion is the most secure way to introduce the shunt tubing into the peritoneal cavity.

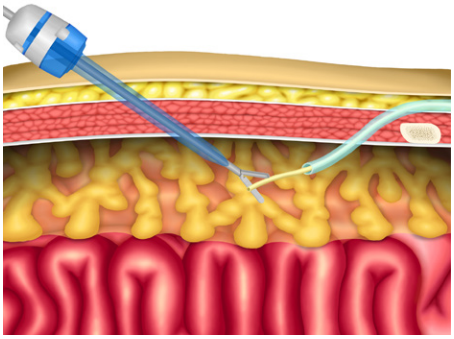

Figure 3. A sagittal cross section showing introduction of the shunt tubing into the peritoneal cavity.

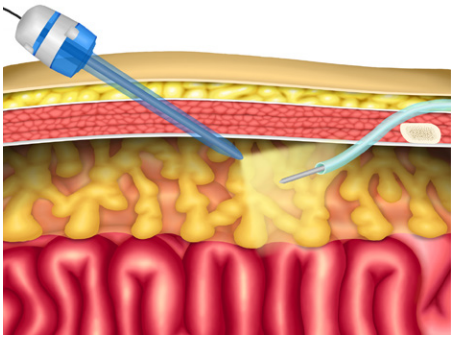

Figure 4. A sagittal cross section showing the tunneling device moving from the subcutaneous space into the peritoneal cavity once it passes the diaphragm and ribs. This is done under direct vision.

Discussion

This technique uses the same amount of trocar entry sites as a standard MIS shunt placement, but without the additional stab incision over the entry site of the shunt catheter. We feel this technique may have several benefits over the standard MIS shunt placement as well as open laparotomy for shunt placement.

By avoiding an abdominal incision, this technique greatly reduces the possibility of wound breakdown and infection over the shunt tubing in the abdomen. The direct tunneling into the abdomen also reduces the risk of obstructive shunt failure by eliminating the potential space where the distal catheter can retract into the abdominal wall and become coiled. The technique also improves the surgeon's comfort during the operation by eliminating lengthy incisions and deep dissections through abdominal fat.

Conclusion

Our technique of tunneling directly into the abdominal wall without using a pull-away introducer sheath is both novel and feasible. In select cases it may prove advantageous. To our knowledge, this is the first time a technique has been described which avoids a stab incision directly over the abdominal entry site of the distal catheter. ■

Acknowledgements

This project has been supported by the Center for Advanced Surgical Technology at the University of Nebraska Medical Center.

Disclosures

The authors have no disclosures or competing interests to mention.

Funding

This project received no funding.

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