Child's Nervous System (2019) 35:1397–1400
https://doi.org/10.1007/s00381-019-04173-5

TECHNICAL NOTE

Laparoscopy-assisted placement of a ventriculobiliary shunt: a technical note

Giovanni Pancucci[1] · Estela Plaza-Ramirez[1] · Carsten Driller[2] · Pablo Miranda-Lloret[1] · Carlos Botella-Asunción[1]

Received: 30 September 2018 / Accepted: 25 April 2019 / Published online: 3 May 2019

Abstract

Purpose Hydrocephalus is a common condition in pediatric neurosurgeon's clinical practice. Peritoneal and atrial shunting is the treatment of choice in the immense majority of patients. Sometimes, there are complex cases that may need innovative solutions in order to implant the distal catheter of the shunt: in these situations, the gallbladder is a well-described option and it can be safely used.

Methods We report the case of a 4-month-old baby with a wide optic-chiasmal hypothalamic glioma generating hydrocephalus with high protein values in CSF. Ventriculobiliary shunting was decided, and the distal catheter was directed by the assistance of laparoscopic surgery.

Results The outcome was satisfactory.

Conclusions As far as we know, laparoscopic placement of a distal catheter in the gallbladder has not been described in the literature; herein, we describe the tenets and the technical tips of this approach.

Keywords Hydrocephalus · Shunt · Ventriculobiliary

Introduction

Ventriculobiliary shunt is a rarely used treatment for pediatric hydrocephalus, usually performed as a second- or third-line treatment when a ventriculoperitoneal shunting is not feasible or fails. Herein, we describe a minimally invasive technique for positioning a ventriculobiliary shunt with the assistance of laparoscopic surgery.

Case

A 4-month-old male presented at emergency with occasional vomiting and altered gaze. At exploration, the anterior fontanel was tense and macrocephaly was observed. The child was also progressively drowsy.

Following US imaging, a gadolinium-enhanced brain MRI was performed (Fig. 1), showing a wide, enhancing, bilateral frontal mass involving the hypothalamus and bilateral optic pathway. Hydrocephalus was also present, together with an augmentation of the extra-axial subarachnoid space.

Patient was briefly managed on emergency by a general neurosurgeon with an external ventricular drainage, thus controlling the intracranial hypertension. A biopsy of the mass was performed and the diagnosis was optic-chiasmal hypothalamic glioma (OCHA).

Placement of a definitive CSF shunt was needed to permanently manage the hydrocephalus and to start the adjuvant therapy as soon as possible. Nevertheless, the biochemical features of CSF, with a high protein concentration (901.5 mg/dL), caused concerns about the feasibility of a ventriculo-peritoneal shunt (VPS); it was also taken on account that the peritoneal venous and lymphatic system would not reabsorb such an elevated amount of proteins, generating associated lymphatic pathways obstruction and eventually ascites. Moreover, although high protein levels in CSF are actually not a contraindication for VPS placement, as occurs in conditions like tuberculous hydrocephalus and some

✉ Giovanni Pancucci
gpancucci@gmail.com

[1] Department of Neurosurgery, Hospital Universitario y Politécnico La Fe, Valencia, Spain

[2] Department of Pediatric General Surgery, Hospital Universitario y Politécnico La Fe, Valencia, Spain

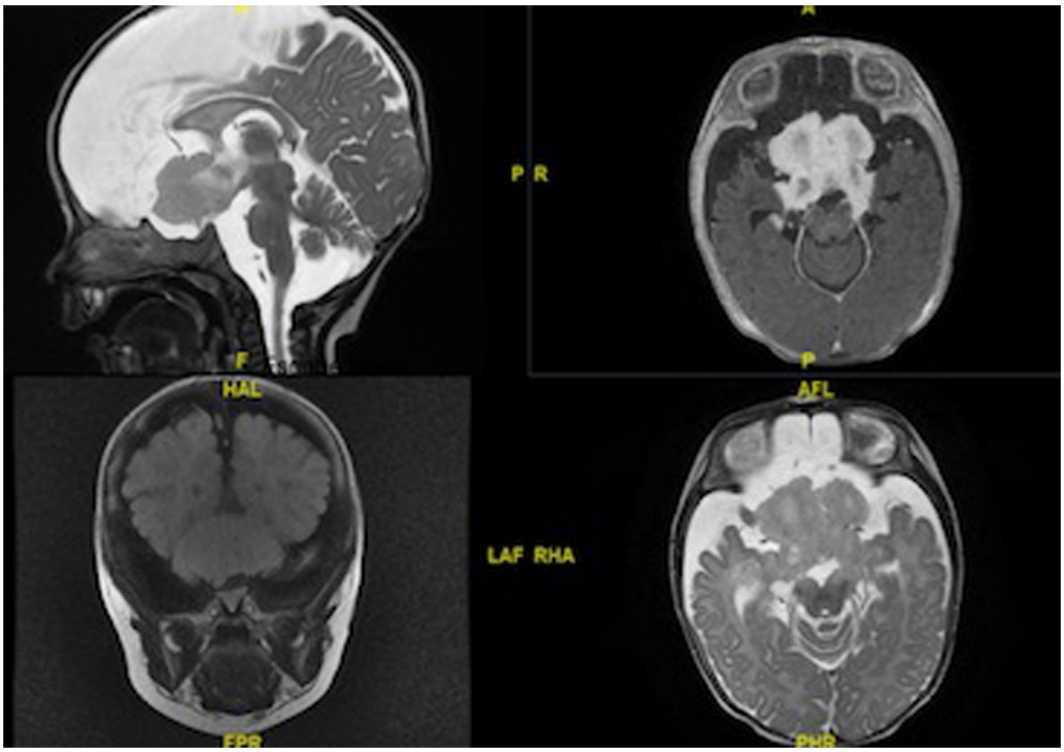

Fig. 1 A wide, enhancing mass is observed at the optic-hypothalamic region, together with hydrocephalus and augmentation of extracerebral subarachnoid space

oncologic cases, proteinaceous ascites is a well-described complication in patients with OCHA treated with VPS [1–3]. Olavarria [4] already showed the role of ventricular gallbladder shunt in infants with OCHA, so we decided that shunting CSF from the ventricular system to the gallbladder was a reasonable first-line treatment in this patient.

Based on previous experiences [5, 6], we found that a subhypocondrial incision was unnecessary and associated with higher postoperative pain; therefore, we decided to place the distal catheter with laparoscopic assistance, in a similar fashion that has already been described with VPS [7].

Laparoscopic assisted ventriculobiliary shunt insertion was performed by an interdisciplinary team including a neurosurgeon and a pediatric general surgeon. A ProGav 2.0 (Miethke Braun) shunt was positioned from a right frontal burr hole with standard technique.

Posteriorly, a three-port laparoscopic approach was performed using a 5-mm umbilical trocar for a 30° telescope and two 3-mm working ports. A carbon dioxide pneumoperitoneum was created with a pressure of 8 mmHg. After the identification of the gallbladder beneath the right lobe of the liver (Fig. 2a), a small incision was performed on its fundus. A 5 cm long, curved tip of a 7 French pigtail catheter was placed in the fundus of the gallbladder (Fig. 2b) with Seldinger technique. A straight connector was positioned to link it with the peripheral derivation. The catheter was first fixed laparoscopically by a purse-string suture and additionally at the level of the straight connector.

The curved form of the pigtail catheter and the straight connector, offering a resistant point to fix the ligation suture, were used to prevent migration of the catheter produced by intestinal peristalsis (Fig. 2b–d).

Postoperative X-ray showed no complications (Fig. 2d). Clinical evolution was good. Patient was discharged in 48 h; at 14-month follow-up, patient showed no complications. The shunt is currently functioning at 6 cmH2O; routine X-ray scans or sonographies are realized and no migration of the catheter's tip has been showed. The patient follows an unrestricted diet with generic advise to avoid an excess of greasy food. Esthetic result was considered satisfactory according to both the opinion of parents and surgical team.

Discussion

It is not uncommon to find complex hydrocephalic patients, in whom it may be necessary to look for places other than peritoneum for implanting the distal catheter: these situations usually include a failure in peritoneal reabsorption (ascites, pseudo-occlusion, peritoneal or portal hypertension, previous abdominal surgery with adhesions, obesity). When peritoneal shunt is not feasible, cardiac atrium is the most commonly used second option. Nevertheless, ventricular atrial shunts have been related with higher incidence of internal jugular vein's thrombosis in children younger than 1 year old [5].

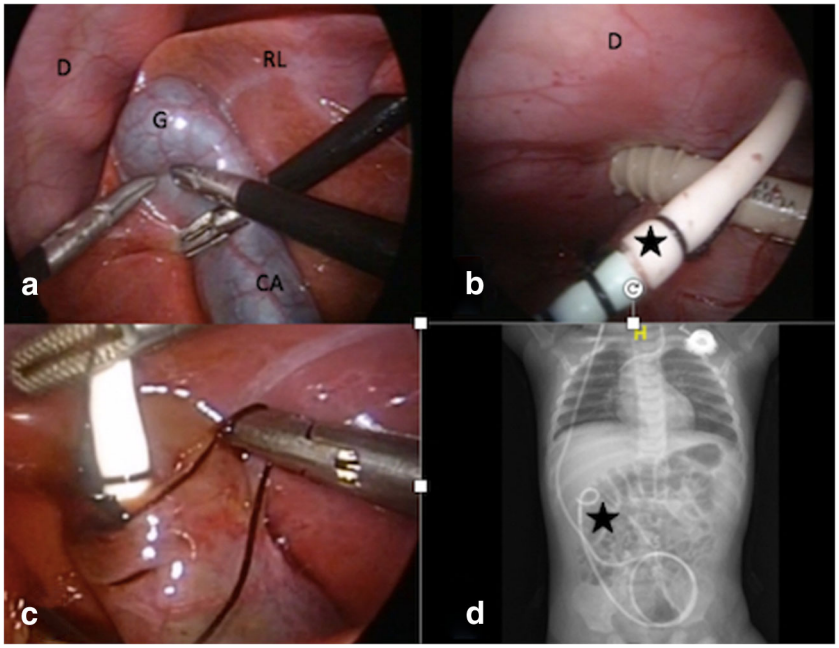

Fig. 2 Phases of the surgery. **a** Laparoscopic identification and preparation of the gallbladder (G). D, diaphragma; RL, right lobe of the liver; CA, cystic artery. **b** Passing of the catheter into the peritoneum under direct visualization. *, distal section of the catheter and connection with pigtail catheter's tip through a straight connector. **c** Insertion of the catheter into the fundus of the gallbladder and ligation. **d** Postoperative X-ray. *, tip of the pigtail catheter allocated into the gallbladder

Ventricular pleural shunts are not recommended under 4 years because they experience higher pleural effusion rate, most likely due to a smaller pleural surface area leading to reduced absorption [8, 9]. Other techniques have been described: "ventriculovascular shunt" to femoral vein [10], bladder [11], omental bursa [12].

Ventriculobiliary shunt's feasibility was first time described by Smith and colleagues in 1958 [13]; late in 1987, West reported his experience in pediatric population [14]. Gallbladder shunting has been always conceived for cases with failure of the peritoneum to absorb CSF.

Shunt-related proteinaceous ascites subsequent to the shunting in children with OCHA is well described in the literature [1–3], and it has been related with a vascular permeability factor produced by the tumor cells which can generate hyper-permeability on peritoneal vessels, thus producing exudation and ascites [15]. Moreover, the high protein content of the CSF may lead to an insufficiency of the lymphatic drainage in the peritoneum to effectively absorb the fluid, which is more evident in young children [1–4]. Olavarria [4] reports that ventriculobiliary shunting can resolve ascites in patients with OCHA since lytic action of bile may breakdown proteins present in the CSF that impair absorption. Based on this previous experience, we selected the ventricular gallbladder as a first option. Moreover, considering the extremely young age of the patient, he was considered too young for an auricular or pleural shunt.

We felt that the classic subhypocondrial incision needed to localize and maneuver the gallbladder was larger than needed for the goal of surgery. In previous experiences [5], the incision was significantly reduced using intraoperative sonographic localization of the gland. Experience on laparoscopic ventriculoperitoneal shunt placement in children under the age of 1 year [7] showed good results, with a reduced operation time and similar blood loss and complications, compared with traditional mini-laparotomy. We thought that a laparoscopic approach could spare the subhypocondrial incision, improving postoperative discomfort and pain.

A three-port laparoscopy allows a complete comfort to the pediatric surgeon. The gallbladder has a small surface, comparing with the peritoneum: it is important to prevent the migration of the distal catheter which can be proximal (exiting from the gallbladder to the peritoneum) or distal (penetrating the biliar pathways). This is the reason why we decided to use the tip of a pigtail catheter and a small straight connector, which was also used as a resistant point for the fixation to the gallbladder, at the end of the peripheral peritoneal catheter.

Conclusions

The ventricular gallbladder shunt is a safe and feasible first-line option in patients with OCHA and hydrocephalus, and seems to prevent ascites in this subgroup of patients.

Laparoscopy, with the collaboration of an experienced pediatric surgical team, can be safely used to position the distal catheter, reducing postoperative scaring and pain.

Compliance with ethical standards

Conflict of interest On behalf of all authors, the corresponding author states that there is no conflict of interest.

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