A new device for endoscopic third ventriculostomy

Technical note

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Since its description by Dandy in 1922, several techniques have been used to perform third ventriculostomy under endoscopic control. Except for the blunt technique, in which the endoscope is used by itself to create the opening in the floor of the third ventricle, other techniques require more than one instrument to perforate the floor of the ventricle and enlarge the ventriculostomy. The new device described is a sterilizable modified forceps that allows both the opening of the floor and the enlargement of the ventriculostomy in a simple and effective way.

The new device has the following characteristics: 1) the tip of the forceps is thin enough to allow the easy perforation of the floor of the ventricle; 2) the inner surface of the jaws is smooth to avoid catching vessels of the basal cistern; and 3) the outer surface of the jaws has indentations that catch the edges of the opening to prevent them from slipping along the instrument’s jaws. The ventricle floor is opened by gentle pressure of the forceps, which is slowly opened so that the edges of the aperture are caught by the distal outer indentation of the jaws, leading to an approximately 4-mm opening of the floor. This device has been used successfully in 10 consecutive patients.

This new device allows surgeons to perform third ventriculostomy under endoscopic control in a very simple, quick, and effective way, avoiding the need for additional single-use instruments.

KEY WORDS • ventriculostomy • endoscopy • hydrocephalus • third ventricle • instrumentation
Fig. 1. Photograph showing the ventriculostomy forceps, a modified endoscopic flexible grasping forceps (outer diameter < 1 mm) with a tip thin enough to allow easy perforation of the floor of the ventricle. Its pointed but blunt shape cannot damage structures like vessels as a needle could. The inner surface of the jaws is entirely smooth to avoid catching vessels of the basal cistern when the jaws are closed and the forceps is removed. The outer surface of the jaws has indentations that catch the edges of the ventriculostomy when the forceps is opened and prevent the edges from slipping along the jaws.

**Double-Balloon Catheter**

As shown in Fig. 2.3, the ventricle floor is punctured by a smooth stylet or more usually by a coagulating probe (2.3a). This instrument has to be removed (2.3b) before the double-balloon catheter (outer diameter fits No. 4 French catheter) is inserted (2.3c). The special shape of the double balloon allows an appropriate placement and an adapted enlargement of the ventriculostomy (2.3c).

**Grasping Forceps**

Figure 2.4 shows that, as with the other previously described techniques, the floor of the ventricle has to be punctured by a different instrument (2.4a and b). The grasping forceps is then inserted (2.4c) and its jaws slowly opened. As with the single-balloon catheter, the edges of the ventriculostomy may slip along the jaws (2.4d) and the forceps must be opened several times before an adequate window is obtained (2.4e). Moreover, when the jaws are closed they reach into the cistern and may grasp a vessel, which could be very dangerous.

**Modified Ventriculostomy Forceps**

As shown in Fig. 2.5, the opening of the floor of the ventricle is performed by gentle pressure of the forceps itself (2.5a). The jaws are then slowly opened to enlarge the window. The outer indentations of the jaws avoid slipping of the ventriculostomy edges from the tip to the basal part of the forceps. The edge is caught by the more distal indentation, and the size of the opening created is thus proportional to the length of the jaws. The opening is approximately 4 mm in diameter, a size that appears to be sufficient for third ventriculostomy (2.5b). Moreover, the inner surface of the jaws is entirely smooth to avoid catching vessels of the basal cistern when the jaws are closed and the forceps are removed. The endoscope (DecqNeuroendoscope; Karl Storz Endoscope GmbH, Tuttingen, Germany), encased in a smaller sheath (outer diameter 3.5 × 4.7 mm), is then introduced into the basal cistern to confirm the patency of the ventriculostomy by the clear observation of the clivus and BA, with no additional membranes.

**Operations**

This modified ventriculostomy forceps has been used in our last 10 patients with no complications. No additional devices have been used to puncture the floor or to enlarge the ventriculostomy (Fig. 3). In each case, the ventriculostomy diameter created has been wide enough to allow the endoscope, which is encased in a smaller sheath (3.5 × 4.7–mm outer diameter) to penetrate into the basal cistern to verify the patency of the ventriculostomy performed. In four cases, the floor was thick, resistant, and difficult to perforate. The use of such a forces allows opening the membranes progressively by gentle dissection, going
deeper and deeper to achieve perforation of the floor with no excessive pressure and consequently possible injury to the adjacent structures, especially the hypothalamus and the mammillary bodies. In one case, a vessel was seen between the jaws of the forceps after their opening (Fig. 4). The smoothness of the jaws allowed us to close the forceps and avoid injuring this vessel by direct compression or by grasping.

Discussion

Our ventriculostomy forceps allows us to perform a rapid and safe third ventriculostomy with only one reusable instrument.

How to Puncture the Floor of the Third Ventricle

Mechanical Puncture. The puncture of the floor of the ventricle cannot be performed with a knife or a needle; the BA and its branches lie just below and could be injured, with fatal consequences. Making an opening with the endoscope itself (the blunt technique) is the simplest but not the safest alternative. The size of the opening is determined by the outer diameter of the sheath, and is difficult to estimate using the view of the floor of the ventricle seen on the video monitor. Moreover, visual control is lost during the procedure, especially control of the mammillary bodies or the infundibular recess, which can be damaged. In some selected cases, the floor is not enlarged enough and the opening is much smaller than the outer diameter of the endoscope. For all of these reasons, this technique is not recommended for third ventriculostomy.

The best solution is probably to use a thin instrument that allows perforation without excessive pressure, which should also be avoided. The advantage of the ventriculostomy forceps described is that it combines a thin, almost pointed tip with the potential for performing a gentle dissection by opening the jaws, especially when the floor is thick and difficult to puncture.

Electrocoagulation. Puncture by using a coagulating probe is commonly performed. Nevertheless, thermal damage created by monopolar coagulation to the hypothalamic region has never been studied and may perhaps explain the fever sometimes observed after third ventriculostomy. Electrocoagulation can be of some help in puncturing the floor of the ventricle. However, in the majority of cases, a simple mechanical puncture is effective. We try to avoid electrocoagulation in every case, except when the floor is very large and floating in the lumen of the ventricle. In such rare cases, coagulation could be used to retract the edge of the ventriculostomy, avoiding its secondary closure.

Laser. The use of such a sophisticated device for puncturing the floor of the ventricle is not really justified. Moreover, lasers present a higher risk of injury to the BA, as already reported.

How to Enlarge the Ventriculostomy

Except for the blunt technique, all the procedures listed require one instrument for puncturing the floor of the ventricle and another for enlarging the opening created.

Single- or Double-Balloon Catheters. The Fogarty catheter is the cheapest and most commonly used device for enlarging a third ventriculostomy. The difficulties with its correct placement and action have been solved by the development of the double-balloon catheter. Too large a balloon catheter should be avoided because it carries the risk of injury to small vessels. Nevertheless, these devices are also single-use products that cannot puncture the floor by themselves and thus create an additional cost of the procedure. Moreover, the outer diameter of the present-
ly available double-balloon catheter is larger than the No. 3 French catheter and cannot be used in small instrument channels.

**Forceps.** Forceps are usually included in the set of endoscopic instruments. They can thus be easily used for performing ventriculostomies. However, the tips of standard forceps are too large for direct puncture of the floor and their use carries the risk of grasping a vessel from the basal cistern. Moreover, the edges of the ventriculostomy slip over the outer surface of the forceps jaws during their opening, leading to some difficulties in creating a wide enough aperture. Our modified forceps have been designed to avoid such phenomena; with a thin, almost pointed tip, outer indentations of the jaws that do not let the edges of the ventriculostomy slip from the tips to the basal part of the forceps, and a smooth inner surface avoids any grasping of basal cistern vessels.

**The Ideal Size of a Third Ventriculostomy**

The optimum diameter of a ventriculostomy is unknown. First, the size of the opening is difficult to measure during surgery. Its shape is often irregular, changing with the cerebrospinal fluid flow beats, and it is not easy to estimate the size through the magnified endoscopic monitor. However, most investigators think that a size of 5 mm should be recommended, although with no scientific basis. Before developing the new device reported here, we used a No. 3 French Fogarty catheter that delivered a mean opening size of approximately 4 mm, which was successful in more than 100 cases.

**Conclusions**

This new device allows performance of third ventriculostomy under endoscopic control in a very simple, rapid, and effective procedure, avoiding the necessity for additional single-use instruments.

**Acknowledgment**

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**Disclosure**

The ventriculostomy forceps was developed with the assistance of Karl Storz Endoscope GmbH, Tuttlingen, Germany. The authors have a licensing agreement with this company for the device described in this study.

**References**


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