Neuroendoscopic Intraventricular Biopsy in Children with Small Ventricles Using Frameless VarioGuide System

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Endoscopic biopsy for intraventricular tumors in pediatric patients with small ventricles is a challenging procedure because of the risk of morbidity during the intraventricular approach. We describe the use of the VarioGuide system for intraventricular endoscopic biopsy in 9 consecutive pediatric patients with intraventricular lesions and small ventricular size. All patients had lesions in the anterior part of the third ventricle with a median frontal and occipital horn ratio of 0.33. Patients presented with growth failure ($n = 4$), visual disturbances ($n = 4$), and seizures ($n = 1$). The VarioGuide system consists of an ergonomic arm with 3 joints for gross adjustment. The 3 rotational joints on the distal side of the system are adjusted according to the angles of the planned trajectory. The endoscope is adjusted to the distal side of the VarioGuide and inserted through the ring, previously set for the diameter of the endoscope and for the planned trajectory. The accuracy of the trajectory and correct ventricular cannulation are confirmed under endoscopic guidance. The biopsy is carried out according to the standard technique. In all cases, the biopsy sample provided the definitive diagnosis. Diagnoses included germinomas in 4 patients, hamartoma in 1 patient, hypothalamic astrocytoma in 2 patients, and craniopharyngioma in 2 patients. The use of the VarioGuide system for intraventricular endoscopic biopsy is highly recommended for pediatric patients with small ventricle size. This technique may help minimize the risk of unnecessary brain damage during the entrance to small ventricles.

INTRODUCTION

Neuroendoscopy did not initially have widespread acceptance because of high morbidity.[1] Advances in techniques and technology have allowed progressive reduction in the rate of complications. One barrier to endoscopy for tumor management has been small ventricle size. Endoscopy was thought to be inadvisable in patients with small ventricles because of concerns about accessing and navigating within the ventricles.[2] Reports of freehand ventriculostomy placement in patients with small ventricles appear to support the use of neuronavigation in endoscopic procedures.[3,4] The size of the endoscope sheath (6 mm) relative to a normal-sized third ventricle and the proximity of the choroid plexus, the internal cerebral veins, and the hypothalamus seem to present increased risk.[5,6] The VarioGuide (Brainlab AG, Feldkirchen, Germany) is a frameless image-guided navigation system with a lockable arm that also works as an instrument holder, and it has been demonstrated to be safe and accurate in brain biopsies.[7] We present a series of pediatric patients with small ventricles who underwent neuroendoscopic intraventricular biopsies guided by a novel application of the VarioGuide system.

MATERIALS AND METHODS

We report a retrospective study comprising 9 consecutive pediatric patients with intraventricular lesions treated during the period 2011–2014. All patients had lesions in the anterior part of the third ventricle and a small ventricular size defined by a frontal and occipital horn ratio ≤ 0.37.[6,8] Preoperative volumetric brain magnetic resonance imaging and computed

Key words
- Endoscopic biopsy
- Intraventricular biopsy
- Neuroendoscopy
- Small ventricle size

Abbreviations and Acronyms
ETV: Endoscopic third ventriculostomy
FSS: Frameless stereotactic system

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tomography scans were obtained and transferred to the iPlan station (Brainlab AG). The entry point was selected considering the nondominant side and avoiding major vessels. The trajectories were chosen according to the main goal of the procedure, defining the first surgical target as the foramen of Monro and the final surgical target as the lesion. We selected the shortest distance from the level of the coronal suture, trying to minimize the need for adjustments of the trajectories within the intraventricular space. The VarioGuide system consists of an ergonomic arm with 3 joints for gross adjustment that is attached to the operating table. It has 3 additional rotational joints in the distal side of the system that are adjusted according to the angles of the planned trajectory. The instruments must be cylindrical and 1.8–8 mm in diameter and are held in the distal side of the VarioGuide system (**Figure 1**).[7,9]

All endoscopic procedures were performed by the senior author (M.B.) with the patient under general anesthesia in a supine position. The head was fixed with a Mayfield-Kees clamp and was placed in such a way that the entry point was the highest point in the surgical field to avoid pneumocephalus. A frontal burr hole was made, the dura mater was opened, and the cortical surface was coagulated. The VarioGuide system was fit together with the Mayfield-Kees clamp and registered to the navigation station, and then the proximal joints were adjusted according to the planned trajectory. A 0° or 30° rigid lens endoscope (Aesculap, B. Braun Melsungen AG, Melsungen, Germany) was used for all procedures. The endoscope was adjusted to the distal side of the VarioGuide and inserted through the ring, previously set for the diameter of the sheath of the endoscope (6 mm in diameter) and the planned trajectory. The accuracy of the trajectory and the correct ventricular cannulation were confirmed under endoscopic guidance. The peel-away sheath was then introduced through the ring of the VarioGuide and fixed with silk in the surgical field. The VarioGuide was removed, and the neuroendoscope was advanced through the peel-away sheath. Intraventricular anatomic landmarks were identified, and the foramen of Monro was carefully entered. The biopsy was performed according to the standard technique. In 2 cases, surgical debulking was necessary because of the compression of the adjacent neural structures. In 1 case, an endoscopic third ventriculostomy (ETV) was required because of another lesion that was obstructing the aqueduct, creating a risk of postoperative hydrocephalus.

RESULTS

There were 6 girls and 3 boys with a median age of 12 years; their clinical features are described in **Table 1**. All patients had lesions in the anterior part of the third ventricle and a small

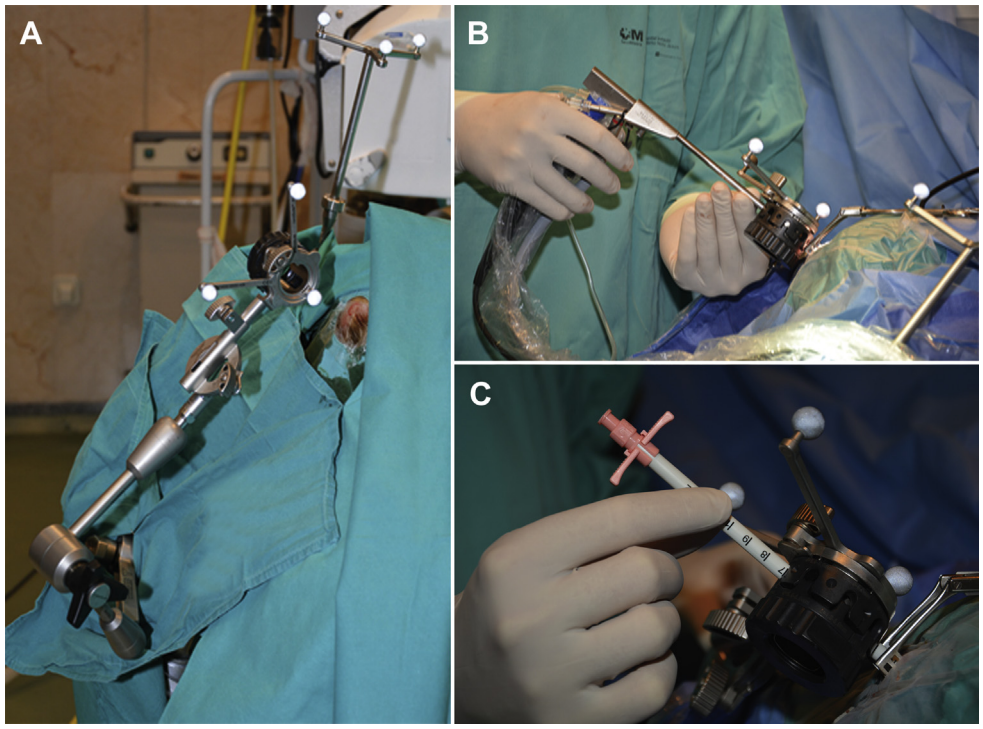

Figure 1. Operative setup of an endoscopic biopsy with the VarioGuide system. (**A**) Photograph of the VarioGuide system fit together with a Mayfield-Kees clamp. (**B**) The VarioGuide system is attached to the operative field, and the angles of the trajectory are adjusted in the navigation software. The trajectory is obtained under endoscopic view through the fixed rim of the VarioGuide. (**C**) A peel-away sheath can also be used inserted through the rim of the VarioGuide.