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Case Report

Dual-port technique in navigation-guided endoscopic resection for intraparenchymal brain tumor

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Abstract

Background: In navigation-guided endoscopic surgery performed via a single port, the interference of surgical instruments often disturbs the resection and hemostasis.

Case Description: With regard to this, we designed a dual-port technique for navigation-guided endoscopic surgery in a 62-year-old man, with intraparenchymal anaplastic astrocytoma. Two transparent sheaths with Nelaton tubes were inserted in the front of the target lesion via an infinity-shaped burr hole, under the control of the navigation system. The lesion was removed partially using a rigid endoscope and several surgical tools through the bilateral ports. Using the new method, it was convenient to perform hemostasis with bipolar coagulation and aspiration, without any interference from the surgical instruments during the surgery.

Conclusion: The offered dual-port technique may be included in surgery planning for elderly patients or patients in particular conditions, with intraparenchymal brain tumors.

Key Words: High-grade glioma, navigation, neuroendoscopy

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INTRODUCTION

Biopsy for diagnosis of intraparenchymal tumors of the central nervous system can be performed by various methods, including needle biopsy, using a stereotactic frame, frameless biopsy with image-guided stereotactic techniques, and open biopsy via a small craniotomy. These methods have advantages and disadvantages in sampling accuracy, approach to deep lesions, and sample volume.[8] In stereotactic biopsy especially, sampling error and the small amount of the sample tissue are the most likely reasons for a relatively low diagnostic yield, although stereotactic biopsy is minimally invasive, with a potentially low complication risk. Even in a frameless biopsy, using a navigation system, there is a potential target registration error.

In recent times, navigation-guided endoscopic surgery has been used for the biopsy or resection of intraparenchymal brain tumors.[1,3,4,6-8] In tumor biopsy, the new method has some advantages over other biopsy procedures, including direct visualization of the lesion, larger sample volume without risk of bleeding, lesser invasiveness, and easy application in both shallow and deep lesions.[8] Furthermore, if the operator challenges the intensive

removal of the lesion, single-port endoscopic surgery has a disadvantage of the operator's handling, due to the interference of surgical instruments, which often disturbs the easy resection and hemostasis procedures. Therefore, we developed a new dual-port technique in navigation-guided endoscopic biopsy, to obtain lesser invasiveness and a larger sample volume than in a single port technique, for a patient with an intraparenchymal high-grade glioma. In this article, we describe the details of the dual-port technique.

CASE REPORT

A 62-year-old man was admitted to our hospital with a 10-month history of motor aphasia. He had a past history of bifrontal oligodendroglioma and underwent right frontal lobectomy in another hospital, followed by bifrontal radiation therapy 30 years before the admission. Additionally, he had a lacuna infarction in the left frontal lobe six years before the admission. On admission, he had mild motor aphasia, with 90% Karnofsky Index of Performance Status (KPS). Magnetic resonance (MR) imaging revealed a heterogeneously enhanced mass lesion, 2.8 cm in maximum diameter, in the left frontal lobe. After careful informed consent and discussion of alternatives, the patient selected partial removal using navigation-guided endoscopic technique to prevent the deterioration of his higher functions, rather than the conventional microsurgical removal.

For navigation-guided endoscopic biopsy, the patient's head was fixed with a Mayfield frame under general anesthesia. Two transparent sheaths with diameters of 6.8 mm (Neuroport®, mini size; Olympus Corp., Tokyo) with Nelaton tubes (Fr 18) as alternative inner tubes were inserted into the front of the target lesion via an infinity-shaped burr hole, under control of the navigation system (StealthStation®, Medtronic, Inc., Minneapolis, MN) [Figure 1]. The front of the lesion was observed with a rigid endoscope (EndoArm®; Olympus Corp. Tokyo, Japan) through the left port, and the lesion was removed partially, using one or two surgical tools, through the bilateral ports [Figure 2].

Partial removal, with 40% removal rate, using the technique described earlier for navigation-guided endoscopic surgery, with photodynamic diagnosis (PDD) and intraoperative pathological diagnosis (IPD), was performed. During the surgery, convenient hemostasis using bipolar coagulation and aspiration, without any interference from the surgical instruments, was easy to perform. MR imaging revealed partial resection of the mass lesion after the surgery [Figure 3]. The patient had no advanced complications, and was discharged from our hospital one week after the surgery. The histological diagnosis was anaplastic astrocytoma.

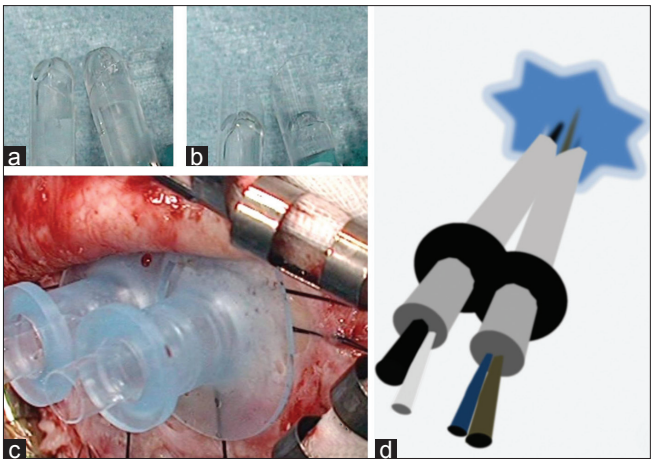

Figure 1: (a, b) Tips of two transparent sheaths with diameters of 6.8 mm (Neuroport® mini size; Olympus Corp., Tokyo) are obliquely cut, and the sheaths are combined with Nelaton tubes (Fr 18) as removal inner tubes. (c) The ports are inserted into the front of the target lesion via an infinity-shaped burr hole under control of the navigation system. (d) Scheme of dual-port technique. The front of the tumor lesion is observed with the rigid endoscope (black tube), with the maximal diameter of 2.7 mm (EndoArm®; Olympus Corp. Tokyo, Japan) through the left port, and the lesion is removed using several surgical instruments (white-gray, blue, and gray bars) via two ports in this scheme

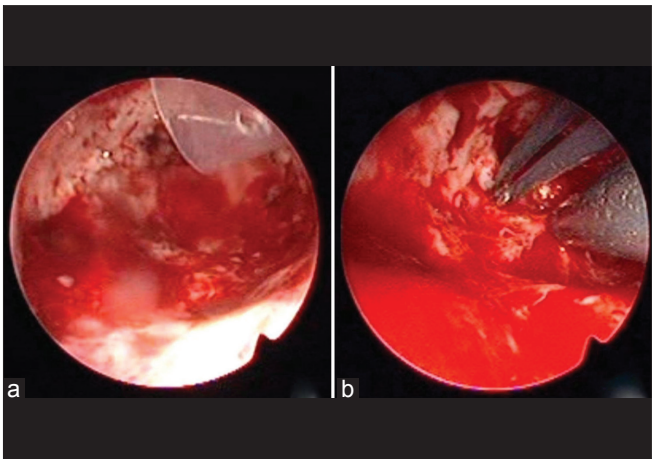

Figure 2: Endoscopic view of the navigation-guided endoscopic surgery using the dual-port technique. (a) The front of the tumor lesion and the right port are observed with the endoscope though the left port. (b) The bleeding point is coagulated with the bipolar forceps, with sufficient aspiration

DISCUSSION

In this article, we have described our first experience of using a dual-port technique in navigation-guided endoscopic resection for an intraparenchymal brain tumor, although for ventricular colloid cysts or for shunt replacement the dual-port technique has been reported previously.[2,5,9] Especially in colloid cysts, the operator can achieve a safe and complete resection by using this method. In the previous cases, operators used the dual-

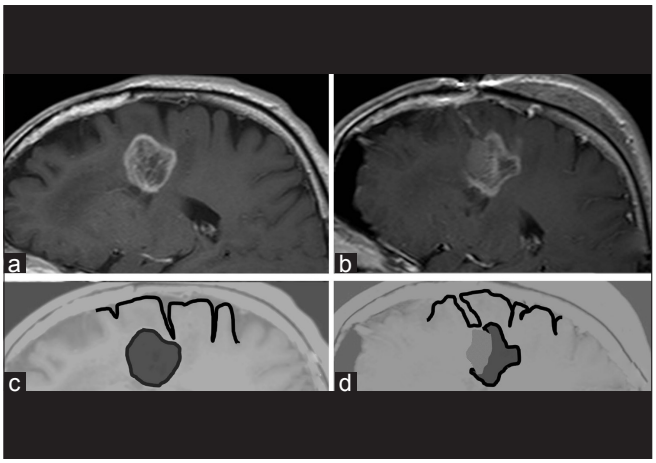

Figure 3: Magnetic resonance imaging revealed partial resection of the mass lesion after the port surgery. Sagittal views and schematic views on T1-weighted gadolinium enhanced images, before (a and c) and after (b and d) the port surgery, demonstrate heterogenous enhancement of the mass lesion

port technique only for intraventricular targets. The ports were used as access routes into the existing ventricular space. In our technique used for the intraparenchymal tumor, the tips of the two ports were composed of a large 'surgical window,' focusing on the artificial tumor cavity, and the operators could utilize multiple surgical devices through the window without interference.

The conventional microsurgical technique will be a better approach for gross-total removal of intraparenchymal malignant tumors. However, in special cases, such as the one described here, when the patient has a high-risk of deterioration in his higher functions due to a previous history of right frontal lobectomy, the operators will have an alternative to choose such an endoscopic surgery. As mentioned in our previous report, tumor biopsy can be done using the single-port technique.[8] However, especially for intensive removal, the interference from surgical instruments often disturbs the convenience of the resection and hemostasis in a single-port technique. Even when using a regular port with a diameter of 10.0 mm, it is difficult to manipulate three devices, including a neuroendoscope, because of considerable instrument interference. In contrast, it is actually easy to use three or four devices in the dual-port technique via two fine ports with diameters of 6.8 mm. From this point of view, the dual-port technique, as in our case, will be a better strategy for reducing instrument interference. Indeed, in the present case, hemostasis using bipolar coagulation and suction, without any interference of the surgical instruments, was easy to perform. Theoretically, gross-total removal can be achieved using this technique, although only partial removal was planned in the described case.

The possible disadvantage of the dual-port technique could be that the brain damage caused by this method may be larger near the sheath tracts than in a single-port technique. However, the sum of squares of two fine ports (2 x 0.36 cm^2) is smaller than that of a single regular port (0.79 cm^2). Moreover, even when using the regular port, the actual severe complication rate is not higher than that of the needle biopsy.[8] Moreover, the bur-hole size in this new method (2.8 cm^2) is also similar to that in the single port method (about 2.2 cm^2). Operators should also care about the small cortical region between the two ports in this new method. We must ensure the safety of this method, including the influence of dual-port insertion on the surrounding brain, via large-scale studies, in the future.

In conclusion, evaluating the first experience of using the new method in the described case, we conclude that the new dual-port technique in navigation-guided endoscopic resection may be considered as an alternative when planning surgery in elderly patients or patients in particular conditions, with intraparenchymal brain tumors.

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