

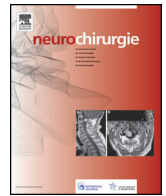


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Original article

The usefulness of fibrin glue as a support in the dissection of malignant cystic brain tumors

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ABSTRACT

Background. – If the complete microsurgical resection of a brain tumor is a logical oncologic goal, the surgical strategy for the cystic component remains controversial secondary to the risk of morbidity. The objective of this study was to analyze the interest of using fibrin glue in the resection of malignant cystic brain tumors (MCBT).

Methods. – Seven patients (median: 60-years-old (range [52–72])/sex ratio M/F: 2.5) were analyzed prospectively in the Neurosurgery Department at Strasbourg University Hospital, from October 2014 to November 2016. The surgical technique consisted of injecting fibrin glue into the tumor cyst after partial drainage. After the solidification of the glue, the cysts walls were removed by following the dissection plan around the fibrin glue. The primary objective was to evaluate the quality of surgical resection on brain MRI scans postoperatively with the use of ITK-SNAP software for precise measurements of tumor volume.

Results. – Four metastases and 3 glial lesions were operated on with this technique. An average reduction in cystic volume of 64.6% ($P=0.016$) and 82.1% ($P=0.016$) for contrast enhancement volume were observed. If two cases (#2 and #7) were excluded, the average contrast enhancement reduction was respectively 94% and 72% for the cystic volume. In addition, there were no complications, tumor recurrence or difference between gliomas and metastases and the Karnofsky score increased by at least 10% in all patients.

Conclusion. – This procedure allowed to extend the resection to the cystic component of MCBT without increasing the risk of morbidity related to injury on the underlying parenchyma.

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1. Introduction

The microsurgical resection of malignant cystic brain tumors (MCBT) is the first step in curative treatment [1] and it has a direct impact on local oncological control [2].

However, cystic tumors are often difficult to completely remove due to the adhesences and thickness of the cyst walls [3]. Moreover,

the theoretical risk of disease spread by diffusion of liquid tumor [4] in the cerebral spinal fluid exists during the surgery [5].

To solve these problems, many technical artifices have been developed to improve the resection of cystic brain tumors:

- the use of patient's blood mixed with thrombin (autologous cryoprecipitate and thrombin) [3];
- or hydrofiber dressing or cotton sheets [6];
- or Pyoktanin blue injection [7].

A new surgical procedure using fibrin glue to improve the resection, without increased brain injury, is proposed.

The objective of this study was to examine the usefulness of fibrin glue in the resection of MCBT.

Abbreviations: MCB, Tmalignant cystic brain tumors; RPA, recursive partitioning analysis; CT scan, computerized tomography scan; MRI, magnetic resonance imaging; NN, neuronavigation; GKS, Gamma Knife surgery; SRS, stereotactic radiosurgery; iMRI, intraoperative magnetic resonance imaging; CSF, cerebrospinal fluid.

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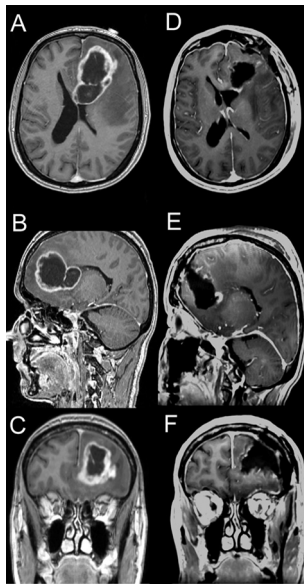


Fig. 1. Case #1 (Table 1); MR images: axial T1 (A, D), sagittal T1 (B, E) and coronal T1 (C, F). All images are contrast-enhanced T1-weighted. Before surgery: fig. A, B, C images showing a large left frontal tumor predominantly cystic producing a mass effect on the adjacent structures. Postoperative images 2 day after surgery: fig. D, E, F images showing a good tumor resection but persistence of a little tumor residue taking the contrast in the wall of the left lateral ventricle.

2. Patients and methods

2.1. Study design

This prospective single center study included 7 patients (median: 60-year-old (range [52–72]/sex ratio M/F: 2.5) operated for MCBT. Data on these patients were collected over a period of 29 months at Strasbourg University Hospital from October 2014 to March 2016.

All cystic brain tumors suspected to be benign with magnetic resonance imaging (MRI) examinations were excluded [8].

Each patient received a thoraco abdominal-pelvic computerized tomography scan (CT scan) to assess the systemic condition and the patient files were discussed during a multidisciplinary meeting with a radiologist, oncologist, pathologist and neurosurgeon in order to propose the best therapeutic strategy (with recursive partitioning analysis score [9] (RPA score) evaluation for metastases) (Figs. 1 and 2).

The primary objective was to evaluate the quality of surgical resection on postoperative brain MRI following surgery.

The secondary objectives were to estimate pre and postoperative Karnofsky score at 2 months, differences between glial tumor and metastasis resections and the possible postoperative complications.

2.2. Surgical procedure

All operations were performed with the aid of neuronavigation (NN) and the surgical microdissection was carried out under an optical microscope.

The technique consisted of performing a craniotomy centered on the tumor using neuronavigation. The NN allowed the operation to be localized on the thinnest and most superficial part of the cyst. Once the tumor was visualized, some of the contents of the tumor cyst were carefully and hermetically aspirated with a Cushing's needle. To limit the diffusion of liquid tumor, the fibrin glue [Tissucol® (Baxter) or Evicel® (Ethicon)] was injected into the lumen of the cyst (5 to 10 mL depending on the size of the lesion) to

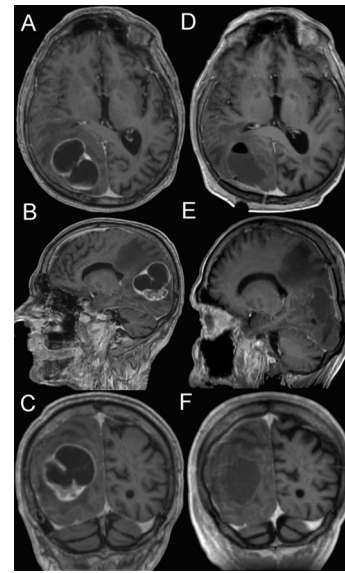


Fig. 2. Case #5 (Table 1); MR images: axial T1 (A, D), sagittal T1 (B, E) and coronal T1 (C, F). All images are contrast-enhanced T1-weighted. Before surgery: fig. A, B, C images showing a right parieto-occipital tumor with a fleshy portion located at the level of the lower part. Postoperative images 2 days after surgery: fig. D, E, F images showing a good resection of the tumor.

replace the tumor fluid (Table 1) and obtain a solid texture similar to the fleshy portion. After few minutes, when the glue thrombus was obtained, the careful resection of the tumor mass and the walls of the cysts was performed (Fig. 3).

The majority of resections were performed in monoblock. If necessary, the resection could be completed, particularly for the fleshy portion.

2.3. Endpoints

The quality of the resection was evaluated as the percentage of reduction in tumor volume (contrast enhancement, the cystic portion and tumor edema) between postoperative MRI (at day +2) versus preoperative MRI by two independent radiologists. Evaluation was carried out on the T1 enhancement by gadolinium for contrast enhancement and the cystic portion volume. And on T2 sequences for comparison of tumor edema volumes. ITK-SNAP software was used for the volume measurements [10].

In order to estimate the patient's functional status, the Karnofsky Performance Status (KPS) [11] were calculated in preoperatively and to postoperatively M + 2.

2.4. Statistical analysis

Continuous variables are expressed as median with interquartile range and compared between preoperative and postoperative period with a Wilcoxon signed rank test (for paired data). Non-removed cystic volume and contrast enhancement volume ratios were calculated and average ratios with 95% confidence intervals were estimated using beta distribution. Comparisons depending on use of fibrin glue were performed using beta regression models. A P -value < 0.05 was considered as statistically significant. Analyses were realized using R software version 3.2.2. R. Core Team (2015). R: a language and environment for statistical computing. R. Foundation for Statistical Computing, Vienna, Austria. URL: <https://www.R-project.org/>.

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