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ORIGINAL ARTICLE

Local hemostatic matrix for endoscope-assisted removal of intracerebral hemorrhage is safe and effective

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Background/Purpose: Minimally invasive endoscope-assisted (MIE) evacuation of spontaneous intracerebral hemorrhage (ICH) is simple and effective, but the limited working space may hinder meticulous hemostasis and might lead to rebleeding. Management of intraoperative hemorrhage is therefore a critical issue of this study. This study presents experience in the treatment of patients with various types of ICH by MIE evacuation followed by direct local injection of FloSeal Hemostatic Matrix (Baxter Healthcare Corp, Fremont, CA, USA) for hemostasis.

Methods: The retrospective nonrandomized clinical and radiology-based analysis enrolled 42 patients treated with MIE evacuation of ICH followed by direct local injection of FloSeal Hemostatic Matrix. Rebleeding, morbidity, and mortality were the primary endpoints. The

Conflicts of interest: This article has not been previously published in whole or in part or submitted elsewhere for review. We hereby certify that, to the best of our knowledge, no aspect of our personal or professional circumstances currently, or in the past 12 months, places us in the position of having a conflict of interest with this study.

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intracerebral hemorrhage

percentage of hematoma evacuated was calculated from the pre- and postoperative brain computed tomography (CT) scans. Extended Glasgow Outcome Scale (GOSE) was evaluated at 6 months postoperatively.

Results: Forty-two ICH patients were included in this study, among these, 23 patients were putaminal hemorrhage, 16 were thalamic ICH, and the other three were subcortical type. Surgery-related mortality was 2.4%. The average percentage of hematoma evacuated was 80.8%, and the rebleeding rate was 4.8%. The mean operative time was 102.7 minutes and the average blood loss was 84.9 mL. The mean postoperative GOSE score was 4.55 at 6-months' follow-up.

Conclusion: This study shows that local application of FloSeal Hemostatic Matrix is safe and effective for hemostasis during MIE evacuation of ICH. In our experience, this shortens the operation time, especially in cases with intraoperative bleeding. A large, prospective, randomized trial is needed to confirm the findings.

Introduction

Minimally invasive endoscope-assisted (MIE) evacuation of intracerebral hemorrhage (ICH) has been shown to be safe and effective, with less morbidity and mortality compared with that of the traditional craniotomy method.[1–3] However, the small working space may hinder meticulous hemostasis. Management of intraoperative hemorrhage is therefore a critical issue. Many have attempted to address the difficulty of achieving hemostasis in a narrow working space under limited visualization using new surgical device or techniques.[4–6]

Local hemostatic agents, such as FloSeal Hemostatic Matrix (Baxter Healthcare Corp, Fremont, CA, USA), is the most efficient and time saving way of attaining hemostasis, with no thermal damage to the normal brain parenchyma. It is used in many different surgical fields.[7,8] It has been proven to help control operative bleeding in cranial and spinal surgery and reduce damage to the surrounding healthy neural tissue while shortening surgical time.[9] Thus, FloSeal Hemostatic Matrix has the potential to facilitate difficult hemostasis encountered in the MIE evacuation of ICH.

This study presents experience in the treatment of patients with various types of ICH by MIE evacuation followed by direct local injection of FloSeal Hemostatic Matrix for hemostasis. To date, this is the first study to report the application of FloSeal Hemostatic Matrix in MIE evacuation of ICH.

Materials and methods

Surgical indications and patient selection

This retrospective nonrandomized clinical and radiology-based analysis enrolled consecutive patients aged from 18 to 75 years who underwent MIE evacuation of ICH with FloSeal Hemostatic Matrix in National Taiwan University Hospital, Yun-Lin branch of National Taiwan University Hospital, Chang-Hua Christian Hospital, and China Medical University Hospital.

The inclusion criteria were spontaneous ICH patients who received MIE evacuation of hematoma followed by application of FloSeal Hemostatic Matrix within 12 hours after onset. The ICH had to fulfill one of the following criteria: (1) a spontaneous putaminal ICH with hematoma volume $>$ 30 mL; (2) a spontaneous thalamic ICH $>$ 20 mL with intraventricular hemorrhage (IVH) and acute hydrocephalus; or (3) a spontaneous subcortical hemorrhage $>$ 30 mL with significant mass effect (midline shift $>$ 5 mm and effacement of the perimesencephalic cistern) and neurological deterioration.

The exclusion criteria were ICH caused by tumor, trauma, coagulopathy (prothrombin time international normalized ratio [PT INR] $>$ 1.3, partial thromboplastin time [PTT] $>$ 35.5 seconds, platelet count $<$ 100,000/μl, intake of antiplatelet medications within 7 days, comorbid end-stage renal disease, or Child Class C liver cirrhosis), aneurysm, or arteriovenous malformation. Those with preoperative Glasgow coma scale (GCS) score $<$ 4 or $>$ 14; no follow-up CT scan within 3 days after surgery; or lost to follow-up at 6 months were all excluded from this study.

In addition, all patients under 45 years old or patients without history of hypertension underwent contrast CT and CT angiography to exclude the presence of a vascular lesion or tumor.

All the patients included in this study had informed consent. This surgical method is the routine management in these four hospitals. Hence, there is no need for an institutional review board (IRB)/ethics committee approval.

Surgical technique

The decision on the surgical approach relied on specific principles.

For putaminal ICHs, the "transtemporal" approach was used. The "frontal" approach was used only when the frontal route provided the shortest distance between the cortical surface and the hematoma, by preoperative CT scan.[10] In patients with hemorrhage on the left or dominant side, the transcortical corridor through the inferior temporal gyrus was used. If ICH was on the right or