

# Neuroendoscopic approach to intracerebral hemorrhages opening to the ventricle

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## ABSTRACT

**Introduction:** Because of the intense contents of the hematoma, the external drainage system is often blocked and cannot function as expected. Subsequently, hydrocephalus develops. In our clinic, the process of hematoma evacuation with the help of neuroendoscopy and placement of external ventricular drainage is carried out in the same session as a treatment for patients with intracerebral hemorrhage opening into the ventricle. This study aimed to show the method we used in our clinic and its results.

**Materials and Methods:** This study evaluated patients who applied to our hospital's brain and neurosurgical clinic with a spontaneous intracerebral hemorrhage diagnosis between January 1, 2020, and January 1, 2023. Of these, 13 patients whose hematoma was evacuated with the help of a neuroendoscope and external ventricular drainage system which was placed in the same session were included in the study. Data such as age, gender, the anatomical region of the bleeding, bleeding volume, external ventricular drainage time, operation time after bleeding, Glasgow coma score, development of hydrocephalus, and mortality of these patients were analyzed.

**Results:** Of the 13 patients who met the criteria of the study, 9 (69.2%) were male and 4 (30.8%) were female. In all patients, the pathology was located in the thalamic (100%). Hydrocephalus was not observed in any patient (0%). Three of the patients became exitus after the procedure (23.1%).

**Conclusion:** We think that endoscopic intraventricular hematoma evacuation is a simple method in the treatment of patients with spontaneous intracerebral hemorrhage opening into the ventricle and has a low risk of complications.

**Keywords:** Intracerebral hemorrhage, neuroendoscope, ventricular hemorrhage

## Introduction

Stroke is one of the most important causes of mortality and morbidity in today's world.<sup>[1,2]</sup> Non-traumatic intracerebral hemorrhage is the second most common cause of stroke. The mortality rate of intracerebral hemorrhages, the reported frequency of 10–55% in studies, is very high.<sup>[2]</sup> Because intracerebral hemorrhage causes high mortality and morbidity, it has significant socio-

economic consequences for society.<sup>[3-5]</sup> Hypertension is the most common cause of spontaneous intracerebral hemorrhage. Causes other than hypertension include vascular malformations, aneurysms, coagulopathies, or the use of antithrombotic/antiaggregant.<sup>[6]</sup>

While small-volume intracerebral hemorrhages are managed with medication or conservative treatments, large-volume hematomas and hemorrhages opening into the



Received: 19.03.2023 Revision: 05.05.2023 Accepted: 10.05.2023

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ventricle with poor neurologic status may require early and aggressive treatment.<sup>[7]</sup>

Opening of the bleeding to the ventricle in patients with intracerebral hemorrhage is one of the prognostic factors.<sup>[8-10]</sup> Because hemorrhage opening into the ventricle often results in hydrocephalus, the planned treatment should usually be surgery to allow the cerebrospinal fluid to be evacuated to another part of the body or temporarily to the outside. In intracerebral hemorrhage opening into the ventricle, it is planned to drain the hematoma together with the cerebrospinal fluid after the external ventricular drainage system is placed. However, because of the intense contents of the hematoma, the external drainage system is often blocked and cannot function as expected. Later, hydrocephalus develops.<sup>[11]</sup>

In our clinic, the process of hematoma evacuation with the help of neuroendoscopy and placement of external ventricular drainage is carried out in the same session as a treatment for patients with intracerebral hemorrhage opening into the ventricle. In the study, we aimed to show the method used in our clinic and its results.

## Materials and Methods

In our study, of patients who applied to the neurosurgery clinic of our hospital with the diagnosis of spontaneous intracerebral hemorrhage between January 1, 2020, and January 1, 2023, those with hemorrhage opening into the ventricle were evaluated. Of these, 13 patients whose hematoma was evacuated with the help of a neuroendoscope and external ventricular drainage system which was placed in the same session were included in the study. Data such as age, gender, the anatomical region of the bleeding, bleeding volume, external ventricular drainage time, operation time after bleeding, Glasgow coma score, development of hydrocephalus, and mortality of these patients were analyzed.

The study was approved by the Clinical Studies Bioethics Committee of the Medical Faculty of Kahramanmaraş Sutcu Imam University (Date: March 03, 2023; Session Number: 2022/06; Decision No: 06).

## Surgical Technique

The patient is prepared by being placed in the supine position under general anesthesia. The process is started by giving 20° of flexion to the neck and fixing the head with a spiked cap. In general, the right hemisphere is preferred,

but if the intracerebral hemorrhage is on the right side, then the left hemisphere is preferred, and planning is made to open a burr hole 3 cm lateral to the midline and 1 cm anterior to the coronal suture. The covering process is performed sterilely, and the burr hole is opened by going under the skin. The dura is punctured with the appropriate technique, then the Foramen Monro is targeted with the help of the endoscope, and the cortex is passed to reach the body of the lateral ventricle. In the meantime, the hematoma is encountered. With the help of an injector (20 cc), the hematoma is slowly aspirated, and then, the procedure is continued. Then, when it is seen that the hematoma in the ventricle has disappeared, the procedure is terminated. An external ventricular drainage catheter is inserted into the lateral ventricle through the same hole. The process is terminated by controlling the cerebrospinal fluid drainage.

## Results

Of the 13 patients who met the study criteria, 9 (69.2%) were male and 4 (30.8%) were female. In all patients, the pathology was located in the thalamic (100%). Hydrocephalus was not observed in any patient (0%). Three of the patients became exitus after the procedure (23.1%). The demographic data of the patients are presented in Table 1.

Spontaneous intracerebral hemorrhage is a disease that can cause severe damage to patients in terms of mortality and morbidity. In intracerebral hemorrhage, conditions such as the patient's age, the patient's state of consciousness, the size of the bleeding, whether it opens into the ventricle, and whether it makes a midline shift are very important for prognosis.<sup>[12-14]</sup>

Development of hydrocephalus in intracerebral hemorrhage opening to the ventricle is also one of the negative factors affecting prognosis.<sup>[8,15,16]</sup> The amount of blood in the ventricle is also important in the development of hydrocephalus. The pressure of the aqueductus cerebri in thalamic hemorrhages may also cause the development of hydrocephalus.<sup>[17]</sup> All 13 patients in our article had bleeding in the thalamic region, and all were opened to the lateral ventricles. In previous studies, the rate of hydrocephalus in supratentorial bleeding was 50%.<sup>[16]</sup>

Antifibrinolytic mechanisms play a role in the breakdown of blood within the ventricle. This process lasts between 3 and 10 days, although it varies.<sup>[18]</sup> Hematoma within the ventricle also has devastating effects on the choroid

**Table 1. Demographic distribution of patients**

Parameter	
Gender	
Male	9 (%69.2)
Female	4 (%30.8)
Total	13 (%100)
Anatomical Localization	
Thalamic	13 (%100)
Total	13 (%100)
Hydrocephalus	
There is	0 (%0)
No	13 (%100)
Total	13 (%100)
Result	
Exitus	3 (%23.1)
Mild disability	6 (%46.2)
Severe disability	4 (%30.8)
Total	13 (%100)
Age (years) (average (minimum-maximum))	73.31±13.40 (45–90)
Hematoma Volume (ml) (average (minimum-maximum))	20.62±9.29 (6–32)
Operation Time (hour) (average (minimum-maximum))	7.08±4.94 (2–18)
EVD time (days) (average (minimum-maximum))	14.85±5.51 (6–24)
Glasgow Coma Score GCS (median value (minimum – maximum value))	10 (5–12)

EVD: External ventricular drainage; GCS: Glasgow Coma Score.

plexus, ependymal cell layer, cerebrospinal fluid viscosity, and cerebrospinal fluid biochemistry.<sup>[19-23]</sup>

Unlike such effects, hematoma in the ventricle can cause hydrocephalus and increased intracranial pressure by blocking the circulation and absorption pathways of the cerebrospinal fluid in the ventricle. This obstruction may be in the form of pressure on the foramen Monro, foramen Magendie, foramen Luschka, aqueductus Sylvius, and villi in the early period due to direct volumetric effect. The late effect of hematoma in the ventricle is in the form of a reaction caused by products such as macrophages and erythrocyte destruction products. Adhesions due to this reaction may also cause hydrocephalus.<sup>[18]</sup>

For the treatment of intracerebral hemorrhage opening into the ventricle, external ventricular drainage can be used alone or in combination with other treatment methods.<sup>[24-27]</sup>

In the application of external ventricular drainage, it is aimed to remove the early hemorrhagic cerebrospinal fluid and small hematoma particles from the ventricular system. Thus, it is aimed to prohibit hydrocephalus which may cause

an increase in pressure in the head. In this way, the effects of increased intracranial pressure, which directly damages the brain parenchyma, and subsequent herniations are prevented. In addition, attempts are made to restore impaired cerebral arterial blood flow, venous drainage, and cerebral perfusion pressure. In the long term, the effects of broken blood products are minimized. In clinical practice, patients with intraventricular hemorrhage in whom external ventricular drainage is placed, experience occlusion of the drainage catheter within a short time, depending on the size of the hematoma in the ventricle. Although it is tried to overcome this problem by intermittent washing of the catheter, this usually results in catheter dysfunction. Thus, as mentioned above, external ventricular drainage placement will not achieve the intended goals.

In this study, we intervened endoscopically in our patients by making the necessary preparations after their application to our clinic. The hematoma in the ventricle was evacuated as much as possible. Thus, the external ventricular drainage catheter we later placed was not blocked in any of our patients and was protected from the volumetric ef-

fect caused by the hematoma. At the same time, since the cerebrospinal fluid drainage was performed regularly, the external ventricular drainage catheter was also protected from the long-term effects of blood products.

### Limitations

In the study, a retrospective review is the most significant limiting point. In addition, because of the limited number of patients in whom the technique application was used, the results of our study are insufficient compared with other methods. However, the most significant advantage of our study, which is a preliminary study, is the demonstration that endoscopic intervention can be used effectively in patients with intraventricular hemorrhage.

### Conclusion

Intraventricular hemorrhage is a poor prognostic criterion for spontaneous intracerebral hemorrhage. Removal of hematoma in the ventricle and regular cerebrospinal fluid drainage prevent hydrocephalus and the increment of intracranial pressure. Thus, it is possible to keep cerebral blood flow and cerebral perfusion pressure at appropriate levels for the patient. The hematoma is removed by endoscopic intervention from the ventricle with a minimally invasive approach to the patient. After this procedure, the external ventricular drainage catheter is enabled to function correctly and as intended.

We think that endoscopic intraventricular hematoma evacuation is a simple treatment method for patients with spontaneous intracerebral hemorrhage opening into the ventricle, has a low risk of complications, and is beneficial for the patient concerning outcomes.

### Disclosures

**Ethics Committee Approval:** The study was approved by the Clinical Studies Bioethics Committee of the Medical Faculty of Kahramanmaraş Sutcu Imam University (Date: March 03, 2023; Session Number: 2022/06; Decision No: 06).

**Peer-review:** Externally peer-reviewed.

**Conflict of Interest:** None declared.

**Authorship Contributions:** Concept – E.C.K.; Design – E.C.K.; Supervision – E.C.K., Z.Y.; Materials – E.C.K., Z.Y.; Data collection and/or processing – E.C.K.; Analysis and/or interpretation – E.C.K.; Literature search – E.C.K.; Writing – E.C.K.; Critical review – E.C.K.

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