Endovascular Treatment with GDC for Severe Acute SAH: Comparison with Early Direct Surgery

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Key words: severe SAH, GDC, outcome, symptomatic vasospasm

Summary

The purpose of this study was to evaluate the effect of endovascular treatment with Guglielmi detachable coils (GDC) on the outcome of severe subarachnoid hemorrhage (SAH) caused by acute rupture of a cerebral aneurysm and on the incidence of symptomatic vasospasm. Thirty-five patients with aneurysmal SAH were treated in the acute stage using GDC. Fifteen out of 17 patients in Hunt & Kosnik grades I, II, and III showed good recovery (GR) at discharge, while one was moderately disabled (MD) and one was severely disabled (SD). Among 16 patients in poor neurological condition (GCS was ≤ 9 on admission), the outcome was GR in 5 cases (31%), MD in 2 (13%), and SD in 9 (56%). These results were better than those for surgically treated patients with the same neurological status. The difference in outcome between endovascular treatment and surgery may have been related to the difference in the insult to the brain caused by each modality.

The incidence of symptomatic vasospasm was lower in the GDC group (5.7%) than in the surgical group (12%). In the patients treated with GDC and intrathecal administration of urokinase, subarachnoid clots were cleared more rapidly than in those treated surgically with continuous cisternal irrigation. The accelerated

clearance of subarachnoid clots in the GDC group might have helped to prevent delayed vasospasm.

The long-term efficacy of GDC embolization in preventing subsequent bleeding has not yet been determined. However, this method seems to be less traumatic for the brain and may be suitable for treatment of patients with severe SAH.

Introduction

Early surgical intervention and aggressive management of delayed vasospasm are now standard procedures in the treatment of patients with a ruptured cerebral aneurysm. However, performing direct surgery on poor grade patients still remains controversial because of the extra insult to the brain already damaged by SAH.

Recently, embolization with Guglielmi detachable coils (GDC) has been recognized as a less invasive treatment for cerebral aneurysm. Since 1997, we have performed GDC embolization followed by aggressive adjunctive therapy in some patients with severe acute SAH. The present study was designed to clarify the effect of this strategy on the outcome in comparison with standard surgery.

Figure 1 Outcome of severe SAH patients (GCS $\leq$ 9).

Clinical Material and Methods

Thirty-five patients (20 women and 15 men aged 37-78 years) presenting with acute rupture of a saccular intracranial aneurysm were treated using GDC in the acute stage. The reasons for performing endovascular treatment in these patients were as follows: poor grade (Hunt & Kosnik grade IV and V) in 18 cases, high age in 5, posterior circulation aneurysm in 8, and other reasons in 4.

We evaluated the following factors: 1) the outcome on the Glasgow Outcome Scale (GOS) at discharge, 2) the adjunctive therapy used after GDC embolization, 3) the outcome of poor grade patients (Glasgow Coma Scale score $\leq$ 9 on admission) compared with 30 surgical patients having the same neurological status and no intracerebral hematoma, 4) the incidence of symptomatic vasospasm (SVS), compared with 74 surgical patients receiving continuous cisternal irrigation with moc-CSF containing ascorbic acid postoperatively, 5) clearance of subarachnoid clots from the basal cistern assessed by serial CT scans in 10 GDC patients and 13 surgical patients with continuous cisternal irrigation, 6) changes of regional cerebral blood flow (r-CBF) assessed by ^{99m}Tc ECD SPECT within 4 days after treatment in 7

consecutive GDC patients and 14 consecutive surgical patients.

Results

Among the 35 patients, only one was in Hunt & Kosnik Grade I, while 8 were Grade II, 8 were Grade III, 11 were Grade IV, and 7 were Grade V. The most common location of the aneurysm was the anterior communicating artery (49%), followed by the vertebro-basilar system (26%), and the posterior communicating artery (20%). Thirty-two patients (94%) underwent GDC treatment within 72 hours of the primary hemorrhage.

Outcome at discharge

No patient showed rebleeding after GDC treatment. All of the 9 patients classified as Hunt & Kosnik Grade I or II achieved good recovery (GR) according to the GOS. Among 8 patients classified as Grade III, 6 achieved GR, one was moderately disabled (MD), and one was severely disabled (SD). Among 18 patients classified as Grade IV or V, 6 (33%) achieved GR, 2 (11%) were MD, and 10 (56%) were SD. None of them died. There was only one compli-

Figure 2 Incidence of symptomatic vasospasm in the surgically treated cases and GDC cases.

cation (2.9%) of the procedure, in which coils placed near the neck of the anterior communicating aneurysm occluded the proximal portion of the left A2.

Adjunctive therapy after GDC embolization

After embolization, patients were managed in the intensive care unit using the same protocol as that for surgical patients. Ventricular drainage (VD) and/or spinal drainage (Sp-D) were used in 27 patients (75%), and decompressive craniotomy was performed in 7 (20%). Intrathecal administration of urokinase was done in 12 patients (34%), and continuous irrigation between the ventricular and spinal drains with moc-CSF containing ascorbic acid was performed in 8 (23%).

Outcome of poor grade patients

Among severe cases with a GCS score ≤ 9 , the outcome at discharge was better after GDC than after surgery (figure 1). The mean GCS score of the 15 GDC cases was 6.1, among whom 5 (33%) achieved GR and 10 (67%) were SD.

In addition, the mean GCS score of the 30

surgical cases was 7.5, among whom 5 (16%) achieved GR, 4 (13%) were MD, 15 (50%) were SD, and 6 (20%) died.

Incidence of symptomatic vasospasm

Normovolemic hyperdynamic therapy and continuous cisternal irrigation were the standard postoperative management for our surgical patients.

With this protocol, the incidence of symptomatic vasospasm after early surgery has decreased to 12% in the most recent period. However, the rate in GDC patients was even lower, and only 2 patients (5.7%) had symptomatic vasospasm (figure 2).

Clearance of subarachnoid clots

The clearance of subarachnoid clots was more rapid in the GDC group than in surgical patients. Figure 3 shows changes of the density in the basal cistern assessed by serial CT scans in GDC patients and surgical patients. The reduction of density (Hounsfield number) was more rapid in GDC patients, especially between day 0 and day 4. In the patients treated with GDC followed by intrathecal administra-

Figure 3 Serial changes of Hounsfield number of basal cistern in GDC treated cases and surgical cases.

tion of urokinase, the decrease was even more marked (figure 4).

Changes of r-CBF within four days after treatment

A decrease of regional CBF around the operative approach route was observed in 10 out of 14 surgical patients and an increase was observed in one when ^{99m}Tc -ECD SPECT was done within 4 days after surgery. However, no changes of regional CBF were observed in seven consecutive GDC patients.

Discussion

Primary brain damage caused by the initial bleeding, rebleeding, and vasospasm are the major reasons for mortality and morbidity in patients with acute rupture of an intracranial aneurysm. Recent technical advances in neurosurgery and neuroanesthesia have allowed ear-

ly surgical intervention to become the basic treatment for prevention of rebleeding and intensive management of delayed vasospasm. However, the use of early surgery for patients with poor grade, high age, poor general condition, and basilar artery aneurysms is still controversial considering the additional insult to the brain caused by direct surgery. Less invasive treatment would be preferable in patients with severe SAH. By endovascular treatment with GDC, an aneurysm can be excluded from the cerebral circulation without brain retraction, small vessel injury, overaspiration of CSF, or temporary occlusion of the parent artery, all of which may possibly occur during direct surgery. In our series, regional CBF did not change after GDC treatment and the outcome for a GCS score ≤ 9 was better in GDC-treated cases than in surgical cases.

These results indicate that endovascular treatment is less invasive than direct surgery, and is thus more suitable for the management

Figure 4 Serial changes of Hounsfield number of basal cistern in the GDC treated cases with/without intrathecal administration of urokinase and in the surgically treated cases.

of severe SAH. Richling performed a retrospective analysis of 220 SAH patients to assess the difference in outcome between GDC and direct surgery¹.

He found that endovascular treatment achieved a better early outcome than direct surgery in H&K grade III patients due to the difference in invasiveness of the two treatment modalities.

In our series, the incidence of symptomatic vasospasm was lower in GDC-treated cases (5.7%) compared with surgical cases (12%). Murayama reported that GDC embolization does not have an unfavorable impact on cerebral vasospasm despite the fact that subarachnoid clots cannot be removed². Yalamanchili reported that the frequency and severity of cerebral vasospasm may be reduced in patients treated by endovascular occlusion compared with those treated by surgical clipping³.

Though the etiology of delayed vasospasm is not fully established, it is apparent that clots in

the subarachnoid space and mechanical stimulation by operative manipulation play an important role in its development⁴⁻¹⁰. With GDC embolization, the subarachnoid space is not damaged and thrombolytic agents can be administered safely.

These advantages may facilitate the more rapid clearance of subarachnoid clots along with the minimal insult to the brain, thus having a favorable impact on the development of delayed vasospasm.

Conclusions

Endovascular treatment of SAH with GDC is less invasive and the incidence of symptomatic vasospasm is lower than after direct surgery.

GDC embolization in the acute stage followed by active adjunctive therapy is expected to be a suitable treatment for patients with severe SAH.

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