DIFFERENTIATED SURGICAL TREATMENT OF PATIENTS WITH HYPERTENSIVE INTRACEREBRAL HEMATOMAS

Hypertensive intracerebral hematoma is one of the most severe forms of cerebrovascular pathology, characterized by high lethality and disability. One of the objectives in providing assistance remains the development of new minimally invasive methods for the removal of hematomas. We have analyzed the results of surgical treatment of 176 patients with intracerebral hematoma. Patients from the 1st group were done open craniotomy. Patients from the 2nd group were performed the external ventricular drainage, also needle aspiration with fibrinolysis. Patients from the 3rd group were performed minimally invasive removal using the original device. Results of treatment were evaluated using Glasgow outcome scale. Lethality was observed in 1st group in 47.8% of cases, in 2nd group in 31.8%, in 3rd group in 29.7%. Minimally invasive technique reduced the postoperative mortality and improved treatment outcomes of patients with intracerebral hematoma.

Keywords: Hypertensive intracerebral hematoma, minimal invasive surgical technique, funnel cannula.

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Introduction

The most common and serious in its consequences vascular brain lesions is a hemorrhagic stroke, characterized by high mortality and disability (Galkina et al., 2002; Mendelow et al., 2005; Skvortsova and Krylov, 2005). In practice, a hemorrhagic stroke often understands as a brain hemorrhage due to hypertension or atherosclerosis (Kariyev, 2006; Krylov et al., 2007). Questions of surgical treatment of hypertensive intracerebral hematomas (ICH) are the most difficult. Compelling advantages in the treatment can be achieved by introducing low-impact removal methods and strict selection of patients for surgical treatment (Lebedev and Krylov, 2000; Nakano et al., 2003; Polyakova, 2005; Shirshov, 2006). The paper presents data treatment using the most common operational practices, as well as the original device for removal of ICH and on the basis of the proposed selection method of surgical intervention.

Subjects and methods

We analyzed the result of surgical treatment of 176 patients with intracerebral hematomas at the age from 41 to 78 years, means age 58.2±10.1 years. The subjects were recruited between January 2005 and June 2009. Men were been113 (64.2%), women - 63 (35.8%).

The main etiologic factor was hypertension. Patients with 1-st stage were 34, with 2-nd stages - 66, with 3-d stages - 76. Level of consciousness: conscious -18, lethargy -63, stupor -55, moderate coma -40. All patients on admission and in the dynamics underwent computer tomography (CT) of the brain. ICH was located in the putamen in 87 cases, thalamus in 19, in the mix area in 50, in the lobar area in 20. Ninety seven patients of them had an intraventricular hemorrhage component. The baseline volume of the ICH was measured according to a bedside method of measuring CT intracerebral hematomas volume.

The volume of ICH less than 40 cm³ was in 36 patients, the volume of 41-60 cm³ was in 47 patients, the volume of 61-90 cm³ was in 60 patients, the volume of 91-120 cm³ was in
27 patients, the volume of hematoma more than 120 cm³ was in 6 patients. Shift of midline structures less than 5 mm was in 69 patients, more than 5 mm - in 107 patients.

Depending on the type of surgery intervention patients were divided in three groups. Patients from 1-st group, 90 patients, were done craniotomy, including 20 observations, where sparing craniotomy performed with using of endoscope techniques as an assistant. At the age of 41-50 years were 31 patients, 51-60 years-33, 61-70 years - 18, more than 70 years - 8. In conscious were 11 patients, in lethargy -33, in stupor - 18, in moderate coma - 18. Putamen hematomas were in 51 patients, thalamic - 3, mixed - 25, subcortical -11. Volume of hematoma less than 40 cm³ was in 11 patients, 41-60 cm³ - in 41, 61-90 cm³ - in 35, 91-120 cm³ - in 16, over 120 cm³ - in 4. Ventricular hemorrhage was noted in 55 patients.

Patients from 2-nd group, 22 patients, were performed the external ventricular drainage (EVD) with subsequent fibrinolytic therapy with urokinase (10000 IU), including 8 cases where the removal of hematoma was performed by punction aspiration with local fibrinolysis. At the age of 41-50 years were 11 patients, 51-60 years-6, 61-70 years-3, over 70 years-2. In conscious were 4 patients, in lethargy - 9, in stupor - 5, in moderate coma - 4. Putamen hematomas were in 5 patients, thalamic - 15, mixed-2. Volume of hematoma less than 40 cm³ was in 20 patients, more than 41 cm³ - in 2. Ventricular hemorrhage was noted in 16 cases.

Patients from 3-rd group, 64 patients, were conducted minimally invasive removal of ICH using the original device (Bersnev et al., 2009). The device - funnel cannula - which after the special markings introduced into the hematoma cavity. Removal of hematoma was carried out using an operating microscope and microsurgical instruments. At the age of 41-50 years were 20 patients, 51-60 years - 25, 61-70 years - 14, more than 70 years - 5 patients. In conscious were 3, in lethargy - 21, in stupor - 22, in a moderate coma - 18. Putamen hematomas was in 31 patients thalamic - 1, mixed-23, subcortical - 9 patients. Volume of hematoma less than 40 cm³ was in 5 patients, 41 - 60 cm³ - in 22, 61-90 cm³ - in 25, 91-120 cm³ - in 10, over 120 cm³ - in 2 patients. Ventricular hemorrhage was noted in 26 cases.

Results of treatment were evaluated in terms of hospital mortality and type of functional outcomes, which used Glasgow outcomes scale. The primary outcomes were feasibility and safety, including recruitment rates, postoperative all-cause lethality. Analyses of continuous normally distributed variables within and between groups were undertaken using the appropriate Student t test. Nonnormally distributed continuous variables were analyzed using the Mann-Whitney U test. Categorical variables were analyzed using Fisher exact test. A probability value of less than 0.05 was considered significant. All statistical tests were 2-sided. Given the exploratory nature of this analysis, no correction was made for multiple comparisons.

**Results**

We had analyzed the case lethality rate, depending on age, the level of impairment of consciousness, the volume and localization of hematoma, presence of intraventricular hemorrhage component and shift of midline brain structures.

Our study showed that age significantly influenced the outcome of the disease. Increasing age of patients has led to an increase in mortality (p<0.05). So, out of 62 patients aged 41-50 died 16 (25.8%), from 15 patients older than 70 years, died 7 (46.7%).

The level of impairment of consciousness was decisive in assessing the severity and significantly influenced the outcome. Lethality rate among patients admitted in conscious was 22.2%, in lethargy - 26.9%, in stupor - 49.1%, in moderate coma - 52.5% (p<0.05). Lethality in patients with putamen hematomas amounted to 36.8%, with thalamic - 47.3%, with mixed - 50%, with subcortical - 15%.

Volume of hematoma more than the localization of hematoma influenced the outcome. Increase the volume of hemorrhage leads to increased lethality (p<0.05). Among patients
with a volume of hemorrhage less than 60 cm³ the lethality was 21.6%, with a volume of 61-90 cm³ - 54.1%, with a volume of 91-120 cm³ - 52.0%, more than 120 cm³ - 100%.

Lethality in patients with intraventricular hemorrhage (IVH) was 54.6% and depended on the intensity and prevalence of breakthrough blood. With increasing signs of dislocation increased lethality of patients (p<0.01). In patients without midline shift of brain structures mortality was 13.3%, with displacement of 1-5 mm - 33.3% and more than 5 mm - 48.6%.

The first group of results of surgical treatment depended on patient age, severity of the condition before the operation, the amount and location of hematoma, the severity of lateral dislocation, the presence and severity of IVH.

Among patients of the first group at the age under 50 years lethality was 29%, more than 50 years was noted increasing of lethality in more than 2 times (p<0.05).

Lethality rate among patients admitted in conscious was 27.3%, in lethargy - 36.4%, in stupor and moderate coma - 60.9% (p<0.05).

Lethality in patients with putamen hematomas was 45.1%. Patients with thalamic location of hemorrhages open craniotomy were ineffective - all operated patients were died. Apparently, this is due to the deep location of hemorrhage and traumatic open surgery.

Lethality with mixed hematomas was 60%, with subcortical hematomas - 18.2%.

Among patients with a volume of hemorrhage less than 40 cm³ lethality was 27.3%, volume of 41-60 cm³ - 25%, volume of 61-90 cm³ - 57.1%, more than 91 cm³ - 62.6 in %.

Using of endoscope technique in the removal of hematoma volume up to 40 cm³ has reduced lethality by 7.5%.

When the volume of hematoma was 41-60 cm³, the results of using endoscope technique did not differ from the results in the group as a whole. When the volume of hematoma was more than 60 cm³, the results of using endoscope technique were worse than in the group as a whole.

In patients with midline shift of brain structures less than 5 mm lethality was 26.3%, and more than 5 mm - 58.7% (p = 0.001).

In patients without signs of hydrocephalus lethality was 10%, with a first degree of hydrocephalus - 45%, with the second and third degree of hydrocephalus - 64% (p<0.05).

The duration of open craniotomy operations amounted to an average of 71±17 minutes.

In the second group the highest lethality was observed in the elderly. So, at the age of 50 years lethality was 36.4%, aged 51-70 years - 28.1% more than 71 years - 50%.

Lethality rate among patients admitted in conscious was 25%, in lethargy - 11.2%, in stupor and moderate coma - 55.6% (p<0.05).

Lethality in patients with putamen hematomas was 20%, with thalamic - 33.3%, with mixed - 50%. In patients with subcortical localization of hemorrhage the method of external ventricular drainage and punction aspiration with local fibrinolytic therapy was not used.

Among patients with a volume of hemorrhage less than 40 cm³ lethality was 25%, more than 41cm³ methods of external ventricular drainage and punction aspiration with local fibrinolytic therapy were ineffective, all operated patients were died.

Patients on the background of IVH mortality was 2 times higher than those without IVH and reached 37.4%. Great influence on disease outcome was the degree of IVH. Thus, in patients with mild to moderate IVH were no deaths, with severe IVH lethality was 60%.

At midline shift of brain structures up to 5 mm in mortality was 28.6%. Displacement of more than 5 mm was a poor prognostic factor for patients with group 2, all operated patients were died.

Imposition of ventricular drainage contributed to the reduction and normalization of intracranial pressure. For example, among patients with no signs of hydrocephalus were
no death-rate, in patients with first and second degree of hydrocephalus lethality was 33.3% in patients with third degree of hydrocephalus lethality - 38.5%.

The duration of these operations amounted to an average of 34±7 minutes.

In the third group under the age of 50 years, lethality was 15%, with over 70 years - 40% (p<0.05).

Among patients operated on in conscious, the death-rate was not been noted, but in lethargy lethality was 19.1% in stupor - 31.8%, a moderate coma - 44.5%.

In patients with putamen hematomas lethality was 25.8%. The method using a cannula was ineffective in the thalamic hemorrhage. In patients with mixed hemorrhage lethality was 39.1%, with subcortical hematomas - 11.1%.

When the volume of hemorrhage was 40 cm³, death-rate was not noted. When the volume of hematoma 41-60 cm³ mortality was 13.7%, with hematoma volume 61-90 cm³ - 48%, with a hematoma volume of more than 91 cm³ - 70% (p<0.05).

In patients with IVH mortality was 46.1%, which was 2.5 times higher than those without IVH (p<0.05).

At midline shift of brain structures up to 5 mm in mortality was 23.8%, more than 5 mm - 32.6% (p>0.05).

No signs of hydrocephalus deaths in Group 3 were not, with the first degree hydrocephalus mortality was 20%, with the second and third degree hydrocephalus - 66.7% (p<0.05).

In group 3 on the first day 28 patients were operated and lethality amounted to 35.7% (10 cases). Within 2-3 days 28 patients were operated and lethality amounted to 28.6% (8 cases). More than 3 days 8 patients were operated, which one of them was died (16.7%).

The duration of minimally invasive operations using a funnel cannula is 39±9 minutes in averaged.

**Discussion**

Results of surgical treatment in 3 groups dependent on patients’ age, degree of impairment of consciousness, hematoma volume, ventricular hemorrhage, the degree of displacement of midline structures of the brain and in less extent dependent on the localization of hematomas.

Comparative analysis of surgical treatment of patients with hypertensive ICH showed that the methods of surgical treatment had a significant impact on disease outcome (Figure 1). The highest lethality was observed in 1-st group - 47.8%, in 2-nd group lethality was 31.8%, in 3-d group lethality was 29.7% and was significantly lower than in 1-st group (p<0.05).

The number of patients with favorable outcomes was more patients in the application of minimally invasive surgery. Thus, in 2-nd group a good recovery and moderate disability occurred in 63.6% of cases, in 1-st group - 33.3% of cases (p<0.05), in 3-nd group - 40.6%.

In 3-d group severe disability was noted in 29.7% of cases, which was 1.5 higher than in 1-st group. In our view, this was due to the fact that a minimally invasive technique makes it possible to save more patients through minimally invasive interventions and reduce the duration of the operation, resulting in this naturally increases the number of patients with severe disability.

Analysis of treatment results showed that the use of open craniotomy was justified in cases of increase of dislocation syndrome when needed was an emergency decompression as an element of critical care benefits. In other cases, the outcomes in 1-st group were worse than others. The use of endoscopy has been most effective in patients with subcortical, putamen and mixed localization and volume of hematoma not more than 40-
The use of endoscopy has been uneffective in patients admitted to stupor and moderate coma.

**Figure 1. The distribution of outcomes in patients with hypertensive intracerebral hematomas by Glasgow outcome scale**

- good recovery: 31.8%, 24.4%, 18.9%
- moderate disability: 14.1%, 26.5%, 4.6%
- severe disability: 8.9%, 14.1%，29.7%
- death: 31.8%, 31.8%, 29.7%

**Figure 2. Indications for open craniotomy**

- Putamen, mixed and subcortical localization of hematoma
  - Volume not more than 40-60 cm³
    - Consciousness: conscious, lethargy and stupor without manifestations symptoms of dislocation of the brain (with dysfunction of the brain)
    - Sparing craniotomy + endoscopic techniques as an assistant
  - Volume more than 90 cm³
    - Consciousness: stupor and moderate coma with manifestation symptoms of dislocation of the brain
    - Open craniotomy as reanimation help

The use of external ventricular drainage was most effective in patients with thalamic and mixed hematomas and volume not more than 40 cm³, including those accompanied by blood entering the ventricles. Punction aspiration in conjunction with local fibrinolysis was effective in patients with hematoma volume less than 30-40 cm³, at midline shift of brain structures no more than 5 mm and no signs of lateral dislocation.

Minimally invasive surgery using a funnel cannula was preferred in patients which putamen was assessed as conscious, lethargy and stupor. When the consciousness is rated as moderate coma, lethality rates in patients 3-d and 1-st group did not differ significantly.
Method of using cannula allowed to refuse from open surgery in most patients with lateral and mixed hematomas, and has improved the outcome. Based on these data suggested the following tactics surgical treatment of patients with hypertensive intracerebral hematomas (Figures 2, 3, 4).

**Figure 3. Indications for External Ventricular Drainage and Punction Aspiration Using Local Fibrinolytic Therapy**

- **Putamen, thalamus and mixed localization of hematoma**
  - Volume not more 40 sm³
  - Consciousness: conscious, lethargy and stupor
  - Symptoms of compression of the brain ± intraventricular haemorrhage or haemotamponation
  - Punction aspiration in conjunction with local fibrinolysis ± external ventricular drainage
- **Consciousness: lethargy and stupor**
  - Intraventricular hemorrhage and haemotamponation ± signs of acute hydrocephalus
  - Punction aspiration in conjunction with local fibrinolysis ± external ventricular drainage
- **Consciousness: moderate coma**
  - Intraventricular hemorrhage and haemotamponation ± signs of acute hydrocephalus
  - External ventricular drainage ± local fibrinolytic therapy

**Figure 4. Indications for Minimally Invasive Method Using a Funnel Cannula**

- **Putamen, mixed and subcortical localization of hematoma**
  - Volume not more than 40 sm³
  - Consciousness: conscious, lethargy, stupor and moderate coma with dysfunction of the brain
  - Minimally invasive surgery with using a funnel cannula
Conclusion

Patients with impaired consciousness to moderate coma, with a hematoma volume of more than 90 cm³ and with pronounced signs of dislocations should be operated open craniotomy.

Endoscopic technique is useful at the putamen and mixed localization of hematomas volume no more than 40-60 cm³ and a violation of consciousness no less than lethargy. In patients with thalamus and mixed localization and volume of hematomas no more than 40 cm³, with intraventricular hemorrhage and signs of acute hydrocephalus, effective use of external ventricular drainage in combination with fibrinolytic therapy and no impairment of consciousness than stupor.

Application of the method of puncture aspiration with local fibrinolytic therapy is useful when hematomas various localizations, including intraventricular hemorrhage and volume no more than 40 cm³, disturbance of consciousness no less than lethargy, no explicit signs of dislocation of the brain.

Patients with hematomas putamen, mixed and subcortical localization and more than 40 cm³ can be operated on a minimally invasive method using a funnel-shaped cannula.

References


Poljakova, L., 2005. The method of puncture-aspiration of hypertensive intracerebral hematoma removal in conjunction with local fibrinolysis” [Metod punkcionno-azprimacionnogo udaleniya gipertenzivnyih vnutrimozgovih gematom v sohetani s lokalnym fibrinolizom], in Russian, Moscow.

Shirshov, A., 2006. Hypertensive supratentorial intracerebral hemorrhage, complications of acute obstructive hydrocephalus and blood entering the ventricular system [Supratentorialnye gipertenzivnie vnutrimozgovie krovoizliyaniyta, oslojenennie ostroy obstuktivnnoy gidrocefal'ley i prorivom krovi v jeludochkovuyu sistem], in Russian, Moscow.