

Research Paper

The Outcome of Surgical Versus Conservative Management in Old Patients With Traumatic Brain Injury



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ABSTRACT

Background and Aim: It is still unclear whether the surgical or conservative approach has the best recovery and the least adverse outcomes after the treatment of patients with traumatic brain injury (TBI), especially the elderly. The use of invasive versus conservative therapies in elderly patients with TBI is controversial, and the current brain surgery procedures for the elderly require further evaluation.

Methods and Materials/Patients: In this retrospective cohort study, the medical records of 238 patients with TBI (119 surgical patients and 119 patients treated with conservative methods) over the age of 65 were reviewed. The patients were compared for the degree of recovery indicated by the Glasgow outcome score (GOS) and postoperative complications.

Results: No difference was found in the primary Glasgow coma scale (GCS) between surgical and conservative approaches, but after two treatment protocols, the assessment of GCS and GOS showed a significant difference between the two groups; however, after adjusting baseline parameters in a multivariable logistic regression model, the difference between the two groups in GCS and recovery state turned to insignificance. There was no difference between surgical and conservative management in the post-treatment sequels, including contusion, hydrocephalus, myocardial infarction, pulmonary infection, and death. However, the recurrence of hematoma was significantly higher in those who were treated by the conservative method even after multivariate regression modeling.

Conclusion: In TBI patients aged over 65 years, surgical management can result in more favorable outcomes compared with the conservative approach.

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Highlights

- It is still unclear which surgical or conservative approach has the best post-treatment recovery in old TBI patients.
- In this retrospective cohort study, the medical records of 238 patients with TBI over the age of 65 were examined.
- After following the two treatment protocols, the assessment of GCS and GOS showed a significant difference between the two groups under study; however, after adjusting baseline parameters in a multivariable logistic regression model, the difference between the two groups in CGS and recovery state turned insignificant.
- The recurrence of hematoma was significantly higher in those who were treated with the conservative method.
- In TBI patients aged over 65 years, surgical management can lead to more favorable outcomes than the conservative approach.

Plain Language Summary

Choosing the approach with the most favorable recovery and the least unfavorable outcomes (surgical or conservative) is still controversial in treating patients suffering from traumatic brain injury, especially the elderly. The current brain surgery procedures used for the elderly group need more appraisal. This retrospective cohort study included the medical records of 238 patients over the age of 65. The recurrence of hematoma was significantly higher in those who were treated with the conservative method even after multivariate regression modeling. The surgical approach is a better choice with more favorable outcomes in TBI patients aged over 65 years old, compared with the other approach.

1. Introduction

Traumatic brain injury (TBI) is one of the most common causes of death in people aged 1 to 45 years in North America and many of those who survive will suffer from significant disabilities that impose many socio-economic burdens [1].

The incidence of TBI is very high in three age groups: children (0 to 4 years), adolescents and young adults (15 to 20), and the elderly (over 65 years) [2]. The mortality rate in patients with TBI is reported to be 25 to 78% [3-5]. It is stated that elderly patients with TBI experience higher mortality, poorer performance, or higher dependence, compared with younger TBI patients [6-8]. Numerous factors, such as lower Glasgow coma scale (GCS) [9-10], previous systemic diseases [11-13], closed basal cisterns, and midline displacement [13] determine the poor prognosis of elderly TBI patients, compared with young patients. Due to the poor outcome and higher mortality of surgical treatment in elderly patients with TBI, many researchers recommend a conservative approach to treating severe TBI [14]. However, some argue that poor outcome is not a justification for

conservative treatment, and conversely, less invasive alternatives can be the cause of poor outcome [15-17]. A study in 2002 indicated that some neurosurgeons were reluctant to transfer elderly patients to surgical centers and performed cautious (supportive) treatment [15]. However, two studies in 2012 and 2014 have reported that invasive treatment can produce better results in TBI in the elderly. Prasad et al. also concluded that the benefits of surgery are unpredictable and surgery should be performed carefully in elderly patients with TBI [17].

The use of invasive therapies versus conservative therapies in elderly patients with TBI is controversial, and the current brain surgery procedures for the elderly require further evaluation. Therefore, in this study, we evaluated the outcome of surgical treatments in patients with TBI over 65 years of age.

2. Methods and Materials/Patients

In this retrospective cohort study, the medical records of 238 patients with TBI over the age of 65 who were admitted to the neurosurgery ward of Poursina hospital in Rasht were reviewed. The files of 119 surgical patients and 119 patients treated with conservative meth-



ods were evaluated. Patients with a GCS score of 12 and below were included. Conservative treatment included lowering cerebrospinal fluid pressure with drugs (such as mannitol serum and diuretics, etc.), as well as keeping patients in the intensive care unit and closely monitoring patients' consciousness and vital signs.

Demographic information, including age and sex, was collected. Information on the severity of admission complications, including cerebral spinal fluid (CSF) leakage, CSF rhinorrhea and otorrhea, recurrence of hematoma, hemorrhagic contusion, hydrocephalus, deep vein thrombosis (DVT), myocardial infarction (MI), and pulmonary problems were extracted at discharge. Complications were compared in the two groups of surgical and conservative treatments. The overall outcome of the patients was extracted based on GOS and a favorable GOS was considered to be at a range of 6-8. Statistical analysis was carried out using SPSS version 23.

Patients whose families did not consent to surgery despite the follow-up of the medical staff were included in the support group. The dissatisfaction of the patient's family was recorded in the patient's file.

3. Results

In the present study, a total of 238 patients were studied, out of which 119 cases underwent surgery and 119 cases underwent supportive or conservative treatment. Baseline characteristics in the study groups are shown in Table 1. There was no significant difference in age, GCS score on admission, mechanism of trauma, and initial clinical manifestations on admission. No significant difference was found in the primary GCS score between the two groups. Surgeries performed in the surgical group included decompressive craniotomy in 32.7%, craniotomy and intracranial hemorrhage (ICH) removal in 26.8%, EVD (IVH and hydrocephalus) in 8.4%, decompressive craniotomy and subdural hemorrhage removal in 22.6%, decompressive craniotomy in 5.8%, and other interventions in 5.8% of patients. A higher GOS score was found in patients who had undergone surgical treatment compared to those with conservative treatment (Table 2). A favorable GOS score was observed in 49.6% and 20.2% of patients in the surgical and conservative treatment groups, respectively ($P=0.001$). The frequency of death during the follow-up period was 6.7% in surgical patients and 9.2% in patients treated with conservative methods without any difference ($P=0.508$).

Table 1. Background characteristics of the traumatic brain injury (TBI) patients in the two study groups

| Characteristics | Mean±SD/No. (%) | | P | |
|-------------------------------------|-----------------|------------|------------|-------|
| | Conservative | Surgical | | |
| Gender | Male | 84(70.6) | 0.778 | |
| | Female | 35(29.4) | | |
| Age (y) | | 67.77±3.92 | 68.47±4.21 | 0.187 |
| Mean Glasgow coma scale (GCS) score | | 10.25±2.41 | 10.16±2.39 | 0.767 |
| GCS score categories | 4-5 | 16(13.4) | 18(15.1) | 0.664 |
| | 6-7 | 54(45.4) | 56(47.1) | |
| | 8-9 | 43(36.1) | 41(34.5) | |
| | 10-12 | 6(5.0) | 4(3.4) | |
| Mechanism of trauma | Car accident | 61(51.3) | 59(49.6) | 0.749 |
| | Falling | 33(27.7) | 38(31.9) | |
| | Others | 25(21.0) | 22(18.5) | |
| Clinical manifestations | Otorrhea | 17(14.3) | 13(10.9) | 0.435 |
| | Rhinorrhea | 11(9.2) | 11(9.2) | 1.000 |

Table 2. The trend of the changes in the Glasgow outcome scale (GOS) score after treatment

| Characteristics | Conservative | Surgical* |
|-----------------|--------------|-----------|
| GOS-1 (death) | 8(6.7) | 11(9.2) |
| GOS-2 | 6(5.0) | 8(6.7) |
| GOS-3 | 4(3.4) | 10(8.4) |
| GOS-4 | 28(23.5) | 46(38.7) |
| GOS-5 | 14(11.8) | 20(16.8) |
| GOS-6 | 0(0.0) | 0(0.0) |
| GOS-7 | 27(22.7) | 17(14.3) |
| GOS-8 | 32(26.9) | 7(5.9) |

*P<0.001



In surgical and conservative treatment groups, an increase in GCS score was revealed in 50.4% and 20.2% of the cases, respectively. There was no change in GCS score in 32.8% and 57.1% of cases in the surgical and conservative treatment groups, respectively. There was also a decrease in GCS scores in 16.8% and 22.7% of cases in the surgical and conservative treatment groups, respectively. In terms of post-treatment complications, there was no significant difference between surgical and conservative management in contusion, hydrocephalus, myocardial infarction, or pulmonary infection; however, the recurrence of hematoma was significantly higher in the conservative treatment group compared to the surgical group. DVT was not reported in any of the treatments (Table 3). In the multivariable logistic regression model (Table 4), no difference was found in the chance

of death between the two treatment types after adjusting baseline parameters. In a similar model (Table 5), we found; however, a difference in the rate of hematoma recurrence between the two groups.

4. Discussion

Management of patients with TBI varies greatly depending on the underlying characteristics of the patients, the extent and mechanism of the trauma, as well as the consciousness and hemodynamic conditions of the patients at the time of admission. In this regard, despite the candidacy of patients for invasive surgical and craniotomy procedures, conservative treatments are considered, especially in the elderly. However, it is not yet clear whether, despite such conservative therapies, the same clinical outcome of the surgery is seen

Table 3. Outcome status following treatments

| Characteristics | | Treatment | | P |
|---------------------------------------|-----------|--------------|----------|-------|
| | | Conservative | Surgical | |
| Glasgow coma scale (GCS) score change | Increased | 24(20.2) | 59(50.4) | 0.001 |
| | Unchanged | 68(57.1) | 40(32.8) | |
| | Decreased | 27(22.7) | 20(16.8) | |
| Recurrence of hematoma | | 1(0.8) | 7(5.9) | 0.031 |
| Contusion | | 6(5.0) | 11(9.2) | 0.208 |
| Hydrocephalus | | 3(2.5) | 5(4.2) | 0.472 |
| Myocardial infarction | | 3(2.5) | 0(0.0) | 0.247 |
| Pulmonary infection | | 3(2.5) | 6(5.0) | 0.308 |



Table 4. The multivariable logistic regression modeling for the assessment of the odds of death following treatments in the presence of baseline parameters as the covariates

| Items | Beta | SE | P | OR | 95% CI for OR | |
|--------------------------------|--------|-------|-------|-------|---------------|-------|
| | | | | | Lower | Upper |
| Type of treatment | -0.346 | 0.332 | 0.298 | 0.708 | 0.369 | 1.358 |
| Gender | 0.202 | 0.366 | 0.581 | 1.224 | 0.597 | 2.510 |
| Age | -0.054 | 0.040 | 0.177 | 0.947 | 0.876 | 1.025 |
| Glasgow coma scale (GCS) score | 0.001 | 0.069 | 0.983 | 1.001 | 0.875 | 1.147 |
| Mechanism | -0.237 | 0.207 | 0.252 | 0.789 | 0.526 | 1.183 |

Hosmer-Lemeshow goodness of fit: Chi-square=5.124, P=0.744



in these patients, or whether conservative treatments in such patients have far more favorable outcomes. Therefore, the present study evaluated and compared the treatment outcomes in two groups of patients with traumatic brain injury cured surgically and supportively.

In the present study, what was obtained from comparing the consequences of surgical and conservative treatments in patients with TBI was that, firstly, in terms of recovery, surgical treatment had a clear advantage over conservative treatment, meaning that the GCS score after treatment in the surgical group showed a more significant increase; however, the pointed difference turned to insignificant after adjusting baseline parameters. Regarding post-treatment complications, the recurrence of hematoma was significantly less common in the surgical group than in the conservative treatment, in which the significance remained significant after multivariate regression modeling. In other words, conservative treatment is not as effective as surgical treatment

in preventing the recurrence of hematoma, and this can also exacerbate the disability of patients due to TBI and thus delay and reduce complete recovery after treatment. Finally, for candidates for craniotomy and open surgery, the use of conservative methods may not significantly reduce recovery and increase the disability of patients but may increase the incidence of hematoma recurrence. It is worth noting that mortality in surgery is less reported than in supportive methods. In our study, the incidence of mortality (GOS score equal to one) in the two groups undergoing surgical and supportive treatment was 6.7% and 9.2%, respectively.

Comparing clinical results between surgical treatment and supportive methods, different studies have reported completely contradictory results. In a study by Prasad et al. contrary to our findings, surgical treatment was significantly associated with poor outcomes and ultimately, it was concluded that the benefits of surgery in these patients were unpredictable and surgery should be performed carefully

Table 5. The multivariable logistic regression modeling for the assessment of hematoma recurrence following treatments in the presence of baseline parameters as the covariates

| Items | Beta | SE | P | OR | 95% CI for OR | |
|--------------------------------|--------|-------|-------|-------|---------------|-------|
| | | | | | Lower | Upper |
| Type of treatment | -1.956 | 1.081 | 0.042 | 0.141 | 0.017 | 0.176 |
| Gender | -0.306 | 0.761 | 0.688 | 0.737 | 0.166 | 3.274 |
| Age | -0.043 | 0.087 | 0.618 | 0.958 | 0.807 | 1.136 |
| Glasgow coma scale (GCS) score | -0.003 | 0.152 | 0.982 | 0.997 | 0.740 | 1.343 |
| Mechanism | 0.389 | 0.525 | 0.459 | 1.475 | 0.527 | 4.127 |

Hosmer-Lemeshow goodness of fit: Chi-square=6.774, P=0.561



in these elderly patients with TBI [18]. However, Wan et al. reported that conservative surgical treatment reduced mortality and improved outcomes in the elderly with intracranial hematoma due to TBI [2]. Moreover, in the study done by Solomon et al. the survival of patients over 80 years of age who had received supportive treatment was not ultimately favorable, even though they were strongly recommended for surgical treatment at the time [19]. In the study by Gregson et al. the long-term optimal outcome in the surgical group was about 10.5% higher than in the supportive group and the mortality rate in the surgery and supportive care groups was 33% vs. 15%, respectively [20]. However, it should be noted that the results of surgery can be influenced by various factors, such as background characteristics, underlying risk factors, surgical technique surgeons' experiences, and type of conservative treatment.

The limitation of this study is that in some cases the surgeons selected more suitable cases for surgery with better outcomes. Another limitation of this retrospective study is the lack of details on pupil reactivity, the location of hematoma, the status of the basal cistern, and the midline shift.

5. Conclusion

The findings of the present study suggest that clinical outcomes (postoperative complications) in patients with TBI undergoing surgical treatment are associated with a more favorable outcome.

Ethical Considerations

Compliance with ethical guidelines

The Research Ethics Committee of [Guilan University of Medical Sciences](#), Rasht, Iran approved this study (ethical Code: 1394/266.) This article is taken from the neurology doctorate thesis that was approved and completed at the [Guilan University of Medical Sciences](#). Written informed consent was obtained from all patients/participants.

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Authors' contributions

Conception and design: Shahrokh Yousefzadeh-Chabok and Zoheir Reihanian; Data collection: Seyed Mohsen Aghapour; Data analysis and interpretation: Enayat Bijani; Drafting and critically revising the article; Final approval: All authors.

Conflict of interest

The authors declared no conflict of interest.

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