ORIGINAL ARTICLE

Effect of hip fracture on prognosis of acute cerebral infarction

Jiawen Yuan[1], Gang Zhu[2], Yuwu Zhao[3]*, Jiankang Huang[4]

Biomedica - Official Journal of University of Health Sciences, Lahore, Pakistan
Volume 37(2):114-118
https://doi.org/10.51441/BioMedica/5-277

ABSTRACT

Background and Objective: The guidelines on the factors to determine whether a patient with concomitant stroke and hip fracture is a good candidate for surgical hip repair are still debatable. This study was carried out to investigate the relationship between the management of acute hip fracture and the recovery of neurological function and prognosis in patients with concomitant acute cerebral infarction.

Methods: Thirty patients with acute cerebral infarction combined with acute hip fracture, who were hospitalized and did not accept surgical treatment, and matched 60 cases as control group having acute cerebral infarction without hip fracture admitted in the same period were selected. The neurological function recovery, hospitalization period, 6 months recovery rate, frequency of complications, and 1 year mortality rate between the groups were compared.

Results: Compared with common acute cerebral infarction patients, the National Institute of Health Stroke Scale/Score of acute cerebral infarction group with hip fracture was higher (7.2 ± 5.4 *vs.* 5.6 ± 4.3, $p = 0.034$). The hospitalization period was prolonged (16.1 ± 8.9 *vs.* 12.2 ± 5.3, $p = 0.041$), and 6 months recovery rate was lower (26.7% *vs*. 53.3%, $p = 0.016$), the frequency of pulmonary infection and lower extremity deep vein thrombosis was higher (30% *vs.* 11.7%, $p = 0.03$; 6.7% *vs.* 0, $p = 0.043$). The 1-year mortality rate in patients with combined hip fracture was higher than in patients with cerebral infarction only.

Conclusion: Acute cerebral infarction combined with hip fracture lead to worse neurological recovery, prolonged hospitalization period, increased complications, decreased patient prognosis, and increased 1 year mortality. Surgical treatment of hip fracture with concomitant acute cerebral infarction may improve the prognosis of patients. According to the statistics of neurological function and mortality after 1 year of telephone follow-up, the prognosis of patients whose Modified Rankin Scale below 3 were considered good.

Keywords: Hip fracture, Acute cerebral infarction, Prognosis, Neurological function, Surgical treatment.

Received: 11 January 2021 **Revised date:** 24 April 2021 **Accepted:** 03 June 2021
Correspondence to: Yuwu Zhao
*Department of Neurology, Shanghai Jiaotong University Affiiated Sixth People's Hospital, Shanghai, China.
Email: wuyu0203zhao@21cn.com
Full list of author information is available at the end of the article.

Introduction

Hip fracture is a worldwide public health problem. The incidence of hip fracture is high among the elderly, and it is an important cause of death and disability of the elderly. The prognosis of patients with this disease is very poor. Many patients cannot recover to the functional state before fracture. Reportedly, up to 40% of patients cannot walk independently after hospital discharge [1]. Nearly, 25% of the patients need long-term care, and 20%-30% of the patients die within 1 year after the onset of the disease [2]. Acute stroke is the leading cause of death and disability worldwide, [3] among which acute ischemic stroke accounts for about 70%. Acute stroke is also an important risk factor for hip fracture. Due to limb hemiplegia in patients with acute stroke, clinical studies have found that acute stroke in elderly patients is closely related to hip fracture, and the risk of falls is significantly increased due to balance dysfunction and sensory impairment. The risk of hip fracture after stroke is 1.5-7 times higher than that of general patients [4-6]. Ramnemark et al. [7] studied 1,139 patients with acute stroke and found that the incidence of hip fracture was 2-4 times higher than that of the general population reported in the literature. Cerebral infarction and fracture have some of the similar risk factors, so patients prone to cerebral infarction are also prone to bone loosening and fracture. The risk factors of post-stroke fracture include osteoporosis, aging, and postural instability. Osteoporosis is the most important risk factor. Fracture after stroke

prones the patient in a disadvantage during the process of rehabilitation, and adversely affects the quality of life after rehabilitation. In clinical observation, the fracture after stroke prolongs the hospitalization period of patients, increases the frequency of complications such as pulmonary infection, venous thrombosis and so on, which may increase the risk of death. For patients with hip fracture after acute cerebral infarction, orthopedics doctors think that acute cerebral infarction is a relative contraindication of surgery, so most of these patients cannot get surgical treatment. However, in few patients, internal fixation or hip replacement after fracture is carried out. Whether surgery is conducive to the recovery of patients' condition and improves the prognosis, there are not many clinical reports on this topic while studies on animal models depict variable outcome. In the present study, the patients with hip fracture after acute cerebral infarction were retrospectively analyzed and the effect of hip fracture on the hospitalization period, neurological function recovery, complication rate, and 1 year mortality rate were compared between the cases with or without surgical treatment.

Methods

Patients with acute cerebral infarction complicated with hip fracture who were hospitalized in Neurology and Orthopedics Departments of the Shanghai Jiaotong University Affiliated Sixth People's Hospital, Shanghai, and Nanjing Lishui People's Hospital, Nanjing, China, from January 1, 2013 to December 31, 2019 were screened by electronic medical record system. The patients' hip fracture on an average occurred within 3-7 days after acute cerebral infarction. Patients with old cerebral infarction and patients with acute cerebral infarction after hip fracture were excluded. Also, the patients with pathological hip fracture were excluded. A total number of 30 patients with acute cerebral infarction complicated with hip fracture were screened. A total of 60 patients with age and gender matched acute cerebral infarction were included as the control group.

All selected patients were compared with baseline laboratory tests including complete blood count, routine biochemistry and brain magnetic resonance imaging/ computed tomography images. Complications during hospitalization (such as deep vein thrombosis, pulmonary infections) through the electronic medical record system were also recorded.

Statistical analysis

The data were analyzed using Statistical Package for the Social Sciences version 20. The quantitative data was expressed as mean ± standard deviation ($\bar{x} \pm s$). The comparison of means between the three groups was conducted by applying independent *t*-test and the qualitative data between groups was compared by applying Chi-square test. $p < 0.05$ was considered to be statistically significant.

Results

The mean age of the 30 patients presenting with acute cerebral infarction combined with hip fracture, who did not accept surgical treatment, was 81.3 ± 8.4 years. There were 15 male and equal number of female patients (M:F ration 1:1). The mean age of 79.6 ± 9.5 years was recorded for the 60 patients in the control group, including 32 male patients (53.3%). The frequency of baseline health status and complications between the two groups is shown in Table 1 with no significant ($p > 0.05$).

Acute cerebral infarction combined with hip fracture affects the recovery of neurological function and prolongs the hospitalization period. The NIH Stroke Scale (NIHSS) score of patients with acute cerebral infarction was 8.2 ± 5.2 at admission, and that of patients with concomitant hip fracture was 8.7 ± 6.3, while there was no significant difference between the two groups ($p > 0.05$). The NIHSS score of patients with hip fracture was 7.2 ± 5.4 at discharge, and the recovery was worse than that of patients with acute cerebral infarction alone ($p = 0.034$). The hospitalization period of patients with concomitant hip fracture group was significantly longer than that of patients with acute cerebral infarction only (16.1 ± 8.9 *vs.* 12.2 ± 5.3, $p = 0.041$). The good recovery rate of patients with concomitant hip fracture was significantly lower than that of patients with isolated cerebral infarction (53.3% *vs.* 26.7%) (Table 2).

The patients with acute hip fracture have high frequency of complications and increased mortality. The frequency of pulmonary infections and deep venous thrombosis of lower limbs in patients with acute cerebral infarction and hip fracture were analyzed. Pulmonary infections of variable severity were observed in 30% patients with hip fracture as compared to 11.7% cases of acute cerebral infarction alone. There was no case of deep vein thrombosis in the acute cerebral infarction group. The 1-year mortality of patients with concomitant hip fracture was significantly higher than that of patients with cerebral infarction alone (23.3% *vs.* 6.7%, $p = 0.027$) (Table 3).

Patients with acute hip fracture recovered well after operation.

The data of 11 patients who were admitted with hip fracture after acute cerebral infarction and who opted surgical management was collected. The NIHSS score on admission and at hospital discharge was 8.4 ± 4.3 and 7.3 ± 4.4, respectively. There was no significant difference between the two groups. Five patients (45.5%) recovered well after 6 months (Modified Rankin Scale score ≤ 3) while 1 patient died within 1 year (11.1%). Rest of the 5 patients were lost

Table 1. *Demographic data and basic diseases of patients.*

	Acute cerebral infarction patients (*n* = 60)	Acute cerebral infarction combined hip fracture (*n* = 30)	*p* value
Gender (male)	32 (53.3%)	15 (50%)	0.765
Mean age (years)	79.6 ± 9.5	81.3 ± 8.4	0.653
Hypertension	33 (55%)	18 (60%)	0.652
Diabetes	20 (33.3%)	9 (30%)	0.750
Atrial fibrillation	11 (18.3%)	6 (20%)	0.849

Table 2. *Neurological function and hospitalization period of patients.*

	Acute cerebral infarction patients (*n* = 60)	Acute cerebral infarction combined hip fracture (*n* = 30)	*p* value
NIHSS admission	8.2 ± 5.2	8.7 ± 6.3	0.606
NIHSS at discharge	5.6 ± 4.3	7.2 ± 5.4	0.034
Hospitalization period (days)	12.2 ± 5.3	16.1 ± 8.9	0.041
6 months recovery rate	32 (53.3%)	8 (26.7%)	0.016

Table 3. *Complications and mortality between two groups.*

	Acute cerebral infarction patients (*n* = 60)	Acute cerebral infarction combined hip fracture (*n* = 30)	*p* value
Pulmonary infections	7 (11.7%)	9 (30%)	0.032
Lower limbs deep venous thrombosis	0	2 (6.7%)	0.043
1 year mortality	4 (6.7%)	7 (23.3%)	0.027

during follow-up. As the sample size of this group is too small hence it was not statistically analyzed and compared.

Discussion

Hip fracture is a common type of fracture in the elderly. A large-scale study in China shows that hip fracture is the second most common type of fracture, only second to distal radius fracture [8]. Hip fracture seriously affects the limb function and quality of life of patients, known as the "last fracture" in life. A single center retrospective study showed that the mortality rate of patients with hip fracture in the non-surgical group was four times higher than that in the surgical treatment group within 1 year and three times in 2 years [9]. Another follow-up study showed that among non-surgical patients, the 30-day mortality rate of long-term bedridden patients was 3.8 times higher than that of patients in early activity group [10]. The study also showed that there was no significant difference in mortality between surgical patients and non-surgical but early active patients. It is suggested that early recovery is very important for patients with hip fracture. The data suggest that pain, bleeding, and inactivity associated with acute hip fractures can lead to inflammation, hypercoagulability, and catabolism, all of which may have adverse consequences. International guidelines recommend hip fracture surgery within 48 hours of the event. This recommendation is based on the results of an observational study that shows that shorter operation time can improve the prognosis of patients [11]. Clinical observation found that acute cerebral infarction combined with acute hip fracture significantly affected the recovery of neurological function and prognosis, and patients were more prone to complications. This retrospective analysis showed that patients with acute hip fracture had higher NIHSS score and longer hospitalization period than patients with cerebral infarction alone, suggesting that the recovery of neurological function was worse. The rate of good prognosis in patients with hip fracture in 6 months was significantly lower than that in patients with common cerebral infarction. The frequency of pulmonary infection and deep venous thrombosis of lower limbs was significantly increased. The 1-year mortality rate in patients with concomitant hip fracture was significantly higher than that in patients with cerebral infarction alone. Vincent and colleagues found that the occurrence of fracture 1 day after acute cerebral infarction could aggravate neuron

damage and dysfunction, which was related to the aggravation of neuroinflammation and oxidative stress [12]. The results of surgical treatment for patients with cerebral infarction complicated with the hip fracture are scarcely reported and the conclusions are inconsistent. One study reported that the mortality rate of hip fracture patients with stroke history was higher than that of patients without stroke history [13]. Similarly, a study from South Korea reviewed 548 patients who underwent hip fracture surgery in their hospital for 5 years [14]. Among them, 77 patients had a history of stroke. There was no significant difference in 1 year mortality between the two groups [14]. At present, there is no case study on surgical treatment of hip fracture after acute cerebral infarction. In our collected cases, the overall treatment effect of patients with acute cerebral infarction complicated with acute hip fracture after surgery is good, including good prognosis, reduced hospitalization period, and minimal complications like pulmonary infections and deep vein thrombosis, but the data was too small to be analyzed statistically. For patients with acute cerebral infarction, whether hip fracture surgery can benefit patients remains to be further elucidated through future clinical trials with larger sample size.

Conclusion

Acute cerebral infarction combined with hip fracture leads to worse recovery of neurological function, longer hospitalization period, more complications, poorer prognosis, and higher 1 year mortality rate as compared to patients without hip fracture. Timely surgical management of hip fracture may improve the prognosis of these patients however the tangible evidence still needs to be developed.

Limitations of the study

The number of samples is small to show the validated results. There is a potential of record-based bias in collection of data; however, it was minimized maximally. In addition, more in-depth prospective trials should be carried out to identify a correlation between surgical management and good prognosis of patients with hip fracture after cerebral infarction.

Acknowledgement

The authors would like to thank Dr. Xia Huijun from the medical record room for her help during data collection. The datasets generated and analyzed during the present study are available from the corresponding author on reasonable request.

Conflict of interest

None to declare.

Grant support & financial disclosure

None to disclose.

Ethical approval

Ethical approval of the study (Letter No. 20130607) was given by the medical ethics committee of the Shanghai Jiaotong University Affiliated Sixth People's Hospital, Shanghai, China.

Author's contribution

CC, DD: Conception and design, drafting and critical revision for important intellectual content.

BB, CC, DD: Analysis and interpretation of data, drafting of manuscript.

All Authors: Approval of the final version of the manuscript to be published.

Author details

Jiawen Yuan[1], Gang Zhu[2], Yuwu Zhao[3], Jiankang Huang[4]

1. Department of Neurology, Shanghai Jiaotong University Affiiated Sixth People's Hospital, Shanghai, China
2. Department of Neurology, Shanghai Putuo District Central Hospital, Shanghai, China
3. Department of Neurology, Shanghai Jiaotong University Affiliated Sixth People's Hospital, Shanghai, China
4. Department of Neurology, Nanjing Lishui People's Hospital, Zhongda Hospital Lishui Branch of Southeastern University, Nanjing, China

References

1. Cooper C. The crippling consequences of fractures and their impact on quality of life. Am J Med. 1997;103(2A):12S–7S; discussion 7S-9S. https://doi.org/10.1016/S0002-9343(97)90022-X
2. Dennison E, Cooper C. Epidemiology of osteoporotic fractures. Horm Res. 2000;54(Suppl 1):58–63. https://doi.org/10.1159/000063449
3. Writing Group Members, Mozaffarian D, Benjamin EJ, Go AS, Arnett DK, Blaha MJ, et al. Heart disease and stroke statistics-2016 update: a report from the American Heart Association. Circulation. 2016;133(4):e38–360. https://doi.org/10.1161/CIR.0000000000000350
4. Kanis J, Oden A, Johnell O. Acute and long-term increase in fracture risk after hospitalization for stroke. Stroke. 2001;32(3):702–6. https://doi.org/10.1161/01.str.32.3.702
5. Pouwels S, Lalmohamed A, Leufkens B, de Boer A, Cooper C, van Staa T, et al. Risk of hip/femur fracture after stroke: a population-based case-control study. Stroke. 2009;40(10):3281–5. https://doi.org/10.1161/STROKEAHA.109.554055
6. Ramnemark A, Nilsson M, Borssen B, Gustafson Y. Stroke, a major and increasing risk factor for femoral neck fracture. Stroke. 2000;31(7):1572–7. https://doi.org/10.1161/01.str.31.7.1572
7. Ramnemark A, Nyberg L, Borssen B, Olsson T, Gustafson Y. Fractures after stroke. Osteoporos Int. 1998;8(1):92–5. https://doi.org/10.1007/s001980050053
8. Zhang Y. Clinical epidemiology of orthopaedic trauma. 2nd ed. New York, NY: Thieme Medical Publishers; 2016. p 688. https://doi.org/10.1055/b-0036-133266
9. Tay E. Hip fractures in the elderly: operative versus nonoperative management. Singapore Med J. 2016;57(4):178–81. https://doi.org/10.11622/smedj.2016071
10. Jain R, Basinski A, Kreder HJ. Nonoperative treatment of hip fractures. Int Orthop. 2003;27(1):11–7. https://doi.org/10.1007/s00264-002-0404-y

11. Bhandari M, Swiontkowski M. Management of acute hip fracture. N Engl J Med. 2017;377(21):2053–62. https://doi.org/10.1056/NEJMcp1611090
12. Degos V, Maze M, Vacas S, Hirsch J, Guo Y, Shen F, et al. Bone fracture exacerbates murine ischemic cerebral injury. Anesthesiology. 2013;118(6):1362–72. https://doi.org/10.1097/ALN.0b013e31828c23f8
13. Youm T, Aharonoff G, Zuckerman JD, Koval KJ. Effect of previous cerebrovascular accident on outcome after hip fracture. J Orthop Trauma. 2000;14(5):329–34. https://doi.org/10.1097/00005131-200006000-00004
14. Nho JH, Lee YK, Kim YS, Ha YC, Suh YS, Koo KH. Mobility and one-year mortality of stroke patients after hip-fracture surgery. J Orthop Sci. 2014;19(5):756–61. https://doi.org/10.1007/s00776-014-0593-4