RETROSPECTIVE OBSERVATIONAL STUDY OF 448 CEREBRAL CONTUSIONS IN A TERTIARY CARE TRAUMA CENTRE: ANALYSIS OF THEIR CLINICAL & RADIOLOGICAL PROGRESSION AND OUTCOME

Neurosurgery

Dr. Sambuddha Dhar	Senior Resident, Department of Neurosurgery, Institute of Medical Sciences- Banaras Hindu University, Varanasi.
Dr. Barnava Pal	Senior Resident, Department of Neuro-Anaesthesiology, Institute of Medical Sciences- Banaras Hindu University, Varanasi.
Dr. Anurag Sahu*	Assistant Professor, Department of Neurosurgery, Institute of Medical Sciences- Banaras Hindu University, Varanasi. *Corresponding Author
Prof. Kulwant Singh	Professor, Department of Neurosurgery, Institute of Medical Sciences- Banaras Hindu University, Varanasi.

ABSTRACT

Introduction: Traumatic cerebral contusion is one of the leading cause of morbidity and mortality in Neurosurgery. Patients can be either treated conservatively or surgically. Many patients who are treated conservatively may have CT scan progression and need surgery secondarily. This retrospective study was designed to study the clinical presentation and interventions predicting CT progression of hematoma and final outcome.

Material And Methods: The study was conducted from April 2017 to December 2019 on all the patients of traumatic cerebral contusions, diagnosed by CT scan. Patients received either conservative treatment initially or underwent upfront surgery, and had at least one other CT scan during the acute hospitalization. Patients clinical history, CT progression and any intervention were noted. The patient's disposition status was classified as discharged home, or to another institution, or whether the patient died.

Results: Among the total 448 patients, 78.5% patients required surgery at presentation. 53.3% had a CT progression after repeat CT scan, among them 109 (48.8%) were operated. CT progression was seen more frequently in patients with coagulation abnormalities. Among patients with history of antiplatelet medication receiving platelet therapy, only 31% patients had CT progression. Patients who has poor initial GCS (Glasgow coma scale), underwent tracheostomy and had secondarily operated due to CT progression were discharged late.

Conclusion: Coagulation defects was an important risk factor for CT progression. Platelet replacement therapy significantly decreased surgical intervention in patients with antiplatelet therapy. Poor initial GCS, secondary surgery and tracheostomy lengthened the hospital stay.

KEYWORDS

Traumatic Brain Injury; Brain Contusion; Contusion Progression; Conservative Treatment

INTRODUCTION

Traumatic cerebral contusion in TBI (Traumatic Brain Injury) forms an important cohort of neurosurgery patients in any trauma centre and one of the leading cause of morbidity and mortality in hospitals¹. They can present with subtle neurological deficits to severely obtunded condition with poor GCS (Glasgow coma scale)^{2,3}. CT (Computed Tomography) scans forms the main modality for investigating and diagnosing this condition. It can present in CT scan as organized clot or in typical salt and pepper appearance with intervening normal parenchyma^{4,7}. These patients can be either treated conservatively or operatively. No fixed level 1 guidelines are available at present for the same⁵. Patients with dropping GCS or poor GCS at presentation who are salvageable or having impending cerebral herniation or significant midline shifts are taken for surgery⁷. Many patients who are treated conservatively for small contusions may progress or increase in size on follow up and may be operated secondarily^{9,10}. Various studies have looked into these aspects. Here in this study we tried to relook at these aspects and analyse the clinical and radiological progression and their effects on outcome.

AIM & OBJECTIVES

To study the clinical presentation and the interventions predicting CT progression of hematoma and final outcome of the patients.

MATERIAL AND METHODS

The study was conducted in the department of Neurosurgery in Institute of Neurosurgery, Banaras Hindu University from April 2017 to December 2019. We included all the patients of traumatic cerebral contusions, diagnosed by CT (computed Tomography) scan for analysis.

All the patients were admitted after clinical assessment under a standard medical protocol and subjected to complete basic clinical hemato-chemical, radio-imaging evaluation. Patients received either conservative treatment initially or underwent upfront surgery, and had at least one other CT scan during the acute hospitalization.

Information was documented for each patient as given in Table 1. Prothrombin time/International normalized ratio (PT/INR) and complete blood counts to show platelet levels, and the characteristics

of the initial and follow-up CT scans with timing of follow-up scans also noted down.

Size of hematoma was measured using the formula ABC/2 where A, B, and C represent the largest dimensions of the hematoma measured at three cardinal directions¹¹. Contusions were again classified as lobar or deep where diencephalon, brainstem, or cerebellum contusion were classified as deep.

Patients with hematoma larger than 50 ml (except temporal hematoma where 20 ml was considered) or midline shift more than 5 mm, impending herniation with GCS better than 3 and not deep as defined above were taken up for surgery upfront. Rest of the patients were kept conservatively. The patients among the conservative group who met the above criteria on repeat CT scan were taken for delayed surgery.

Neurosurgical intervention used were: ICP monitoring, craniotomy and evacuation of hematoma, or decompressive craniectomy. Outcome measures were assessed radiologically and clinically. A significant increase in contusion size was defined as an enlargement of more than 30% of the original hematoma size on CT scan¹². The patient's disposition status was classified as discharged home, or to another institution, or whether the patient died.

Statistical analysis was done using SPSS software. Students t test, chi square and multivariate logistic regression analysis was applied wherever applicable. Statistical significance was set at a probability value of <0.05.

RESULT

We did a retrospective study on 448 patients at Banaras Hindu University from April 2017 to December 2019 where we included all the patients of cerebral contusions for analysis. Average age of the patients was 34.16 yrs. Male-Female ratio was 2.74. At presentation, 46.6% patients were having GCS between 14-15 and 20.1% patients had GCS <8 (coma). CT scan showed 26.6% patients had deep contusion and were not amenable to surgery. 33% patients had coagulation disorders in the form of deranged PT/INR and 12.9% patient had history of taking antiplatelet therapy; which were corrected preoperatively.

26.8% had large (>50ml, ml-millilitre) contusions. Among them, 78.5% patients required surgery at presentation. Rest were either in GCS 3 or had deep contusions. 46.4% of total patients underwent surgery. This includes the patients who had significant CT scan progression of hematoma.

Table-1: Summary Of Patient Characteristics And Outcome

Variable	Sub-parameter	No. of Patients (%)
Disposition	Home	238 (53.1)
	To other Institute/ Died	210 (46.9)
Gender	Male	330 (73.7)
	Female	118 (26.3)
Coagulopathy	Yes	148 (33.0)
	No	300 (67)
Antiplatelet therapy	Yes	58 (12.9)
	No	390 (87.1)
Deep Contusion	Yes	118 (26.3)
	No	330 (73.7)
GCS score	Mild	208 (46.4)
	Moderate	150 (33.5)
	Severe	90 (20.1)
Contusion size	<10 ml	148 (33.0)
	10-25 ml	130 (33.5)
	25-50 ml	30 (6.7)
	>50 ml	120 (26.8)
Intervention	Yes	208 (46.4)
	No	240 (53.6)
Tracheostomy	Yes	120 (26.8)
	No	328 (73.2)

Among the total 448 patients, in 239 patients (53.3%) had a CT progression after doing repeat CT scan, among them 109 (48.8%) were operated for significant progression of hematoma and GCS changes. CT progression was seen more frequently in patients with coagulation abnormalities and who were significantly less in patients who had been given antiplatelet therapy. A better GCS was predictive of early discharge of the patients. Patients who had no tracheostomy and who had been treated conservatively successfully were discharged earlier. Patients who were secondarily operated due to CT progression were discharged late compared to the patients who were operated upfront. Average hospital stay for patients who underwent upfront surgery was 28.5 days and those who had CT progression and secondarily operated later on had average hospital stay of 42.3 days. Among the 148 coagulopathy patients, 58 had low platelet levels and were give platelet therapy and only 18 had a CT progression and needed surgery.

Table-2: Relation Of CT Progression With Intervention, Coagulopathy & Antiplatelet Therapy

CT progression	Intervention		Coagulopathy		Antiplatelet therapy	
	Yes	No	Yes	No	Yes	No
Yes	99	110	69	140	18	180
No	109	130	79	160	40	210
Total	208	240	148	300	58	390

DISCUSSION

In our study, mean age is found to be 34.16 years and male predominance is seen, which is similar to a study by Oretel, et al.¹². Similarly, GCS score of 13-15 in 46.4% patients and incidence of deep contusion and coagulopathy is alike.

53.3% patients had CT progression in our study, which is similar to the rates of progression reported by Oretel et al.¹² 51%, Stein et al.¹³, 44% and 51% by Narayan et al.¹⁴ However, our results were higher than the 38% reported by Chang et al.⁵, due to reporting of small contusions.

Coagulation defect found to be an important factor for radiological progression. Coagulopathy includes patients previously receiving antiplatelet therapy or evolving coagulopathy in TBI. Incidence of clotting abnormalities in TBI patients is reported to vary from 15–100%¹⁵.

In our study, 33% of patient had coagulopathy. Patient receiving platelet were found to having lower CT progression. Similar result was found by study Schnüriger, et al.¹⁶, but contradicted by Holzmacher, et al.¹⁷. They concluded that platelet transfusion does not improve

outcomes in patients on antiplatelet therapy following TBI.

The association between radiological progression and a worse outcome has been previously reported by Stein, et al.¹³. Similar correlation also found in later studies^{18,19}. But Alhamadi, et al. showed not all patients with radiological progression show clinical deterioration or require surgical intervention²⁰. In our study, 53.3% had a CT progression after repeat CT scan, and 48.8% of them required surgery.

In the present study, a poor GCS score associated with longer hospital stay, which was previously found by some studies^{2,3,21}. A longer hospital stay was found in patients who underwent delayed surgery due to CT progression compared to the patients who underwent upfront surgical intervention.

The limitations of our study include its retrospective design, lack of a protocol for the timing of CT scans, and relatively small sample size. A larger cohort is required to generate more significant result and to find the predictors of neuro-surgical interventions.

CONCLUSION

Coagulation defects was an important risk factor for CT progression of contusion. Platelet replacement therapy in patients with history of antiplatelet therapy decreased surgical intervention in patients. Better GCS at presentation and successful conservative intervention shortened the hospital stay for patients. A longer hospital stay was noted in patients who underwent delayed surgery due to CT progression compared to the patients who underwent upfront surgical intervention.

REFERENCES

- [1] Kamal, V. K., Agrawal, D., & Pandey, R. M. (2016). Epidemiology, clinical characteristics and outcomes of traumatic brain injury: Evidences from integrated level 1 trauma center in India. *Journal of neurosciences in rural practice*, 7(4), 515–525.
- [2] The Brain Trauma Foundation. The American Association of Neurological Surgeons. The Joint Section on Neurotrauma and Critical Care. Age. (2000). *Journal of neurotrauma*, 17(6-7), 573–581.
- [3] The Brain Trauma Foundation. The American Association of Neurological Surgeons. The Joint Section on Neurotrauma and Critical Care. Glasgow coma scale score. (2000). *Journal of neurotrauma*, 17(6-7), 563–571.
- [4] Bullock, R., Golek, J., & Blake, G. (1989). Traumatic intracerebral hematoma--which patients should undergo surgical evacuation? CT scan features and ICP monitoring as a basis for decision making. *Surgical neurology*, 32(3), 181–187.
- [5] Chang, E. F., Meeker, M., & Holland, M. C. (2006). Acute traumatic intraparenchymal hemorrhage: risk factors for progression in the early post-injury period. *Neurosurgery*, 58(4), 647–656.
- [6] Servadei, F., Nanni, A., Nasi, M. T., Zappi, D., Vergoni, G., Giuliani, G., & Arista, A. (1995). Evolving brain lesions in the first 12 hours after head injury: analysis of 37 comatose patients. *Neurosurgery*, 37(5), 899–907.
- [7] Soloniuk, D., Pitts, L. H., Lovely, M., & Bartkowski, H. (1986). Traumatic intracerebral hematomas: timing of appearance and indications for operative removal. *The Journal of trauma*, 26(9), 787–794.
- [8] Bullock, M. R., Chesnut, R., Ghajar, J., Gordon, D., Hartl, R., Newell, D. W., Servadei, F., Walters, B. C., Wilberger, J., & Surgical Management of Traumatic Brain Injury Author Group (2006). Surgical management of traumatic parenchymal lesions. *Neurosurgery*, 58(3 Suppl), S25–iv.
- [9] Cooper, P. R., Maravilla, K., Moody, S., & Clark, W. K. (1979). Serial computerized tomographic scanning and the prognosis of severe head injury. *Neurosurgery*, 5(5), 566–569.
- [10] Gudeman, S. K., Kishore, P. R., Miller, J. D., Girevendulis, A. K., Lipper, M. H., & Becker, D. P. (1979). The genesis and significance of delayed traumatic intracerebral hematoma. *Neurosurgery*, 5(3), 309–313.
- [11] Kothari, R. U., Brott, T., Broderick, J. P., Barsan, W. G., Sauerbeck, L. R., Zuccarello, M., & Khoury, J. (1996). The ABCs of measuring intracerebral hemorrhage volumes. *Stroke*, 27(8), 1304–1305.
- [12] Oertel, M., Kelly, D. F., McArthur, D., Boscardin, W. J., Glenn, T. C., Lee, J. H., Gravari, T., Obukhov, D., McBride, D. Q., & Martin, N. A. (2002). Progressive hemorrhage after head trauma: predictors and consequences of the evolving injury. *Journal of neurosurgery*, 96(1), 109–116.
- [13] Stein, S. C., Spettell, C., Young, G., & Ross, S. E. (1993). Delayed and progressive brain injury in closed-head trauma: radiological demonstration. *Neurosurgery*, 32(1), 25–31.
- [14] Narayan, R. K., Maas, A. L., Servadei, F., Skolnick, B. E., Tillinger, M. N., Marshall, L. F., & Traumatic Intracerebral Hemorrhage Study Group (2008). Progression of traumatic intracerebral hemorrhage: a prospective observational study. *Journal of neurotrauma*, 25(6), 629–639.
- [15] Stein, S. C., & Smith, D. H. (2004). Coagulopathy in traumatic brain injury. *Neurocritical care*, 1(4), 479–488.
- [16] Schnüriger, B., Inaba, K., Abdelsayed, G. A., Lustenberger, T., Eberle, B. M., Barmparas, G., Talving, P., & Demetriades, D. (2010). The impact of platelets on the progression of traumatic intracranial hemorrhage. *The Journal of trauma*, 68(4), 881–885.
- [17] Holzmacher, J. L., Reynolds, C., Patel, M., Maluso, P., Holland, S., Gamsky, N., Moore, H., Acquista, E., Carrick, M., Amdur, R., Hancock, H., Metzler, M., Dunn, J., & Sarani, B. (2018). Platelet transfusion does not improve outcomes in patients with brain injury on antiplatelet therapy. *Brain injury*, 32(3), 325–330.
- [18] Chieragato, A., Fainardi, E., Morselli-Labate, A. M., Antonelli, V., Compagnone, C., Targa, L., Kraus, J., & Servadei, F. (2005). Factors associated with neurological outcome and lesion progression in traumatic subarachnoid hemorrhage patients. *Neurosurgery*, 56(4), 671–680.
- [19] Servadei, F., Murray, G. D., Penny, K., Teasdale, G. M., Dearden, M., Iannotti, F., Lapiere, F., Maas, A. J., Karimi, A., Ohman, J., Persson, L., Stocchetti, N., Trojanowski, T., & Unterberg, A. (2000). The value of the "worst" computed tomographic scan in

- clinical studies of moderate and severe head injury. European Brain Injury Consortium. *Neurosurgery*, 46(1), 70–77.
- [20] Alahmadi, H., Vachhrajani, S., & Cusimano, M. D. (2010). The natural history of brain contusion: an analysis of radiological and clinical progression. *Journal of neurosurgery*, 112(5), 1139–1145.
- [21] Demetriades, D., Kuncir, E., Velmahos, G. C., Rhee, P., Alo, K., & Chan, L. S. (2004). Outcome and prognostic factors in head injuries with an admission Glasgow Coma Scale score of 3. *Archives of surgery (Chicago, Ill. : 1960)*, 139(10), 1066–1068.