

Role of repeat CT scan head in initially inoperable cases of traumatic head injury

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ABSTRACT

The CT scan has become popular in cases of head injury. In this study 71 cases (M:48; 68.0% and F:23; 32.0%) with traumatic head injury admitted and initially managed conservatively at National Neurosurgical Referral Centre, Bir hospital starting from May 2005 to April 2006. The most common cause of injury was road accidents (43 cases) with motorcycle and bus injuries as the leading causes. Nausea and vomiting were the most common symptom in 41 (57.0%) cases, followed by headache in 31 (43.0%). Contusions were the most common radiological findings in 84.0% followed by extradural haematoma in 8.0% and pneumocephalus in 7.0%. Out of these the most common location for contusion was frontal (16 cases), followed by parietal (12 cases) and then bilateral contusions. The mean volume was 12 ml, 9 ml and 9 ml for frontal, parietal and temporal contusions, respectively. Repeat scan showed increase in volume of contusion in 31 cases (44.0%), no change in 28 cases (40.0%) and decrease in 12 cases (16.0%). The increase was mainly due to edema in 20 cases (64.0%) and due to actual increase in contusion in only 11 cases (35.0%). Only 5 (7.0%) cases needed operative intervention. It is concluded that routine use of repeat scan in mild to moderate head injury has no role unless there is clinical deterioration.

Keywords: Cerebral contusions, CT scan, Glasgow Coma Score (GCS), head injury, trauma.

INTRODUCTION

The availability of CT scan has popularized its use in cases of head injury. Although it is used widely in trauma the indications for repeat scan are not well defined. In patients managed conservatively the role of repeat scan has been a subject of debate.^{1,4,9-12} The economic burden imposed on the patient, especially in developing countries has to be carefully weighed before ordering repeat scans. The extent of information the second or repeat scan provides than the initial scan or control scan varies from study to study.⁷ Different studies have reported conflicting conclusions on the advantage and disadvantage of doing routine CT scan.⁹⁻¹² Since majority of the relevant pathological changes develop within the first forty-eight hours a pathological categorization using the initial scan has also been proposed for prognostic purposes.

MATERIAL AND METHODS

This is a prospective study that included cases with traumatic head injury admitted and initially managed conservatively at National Neurosurgical Referral Centre, Bir hospital starting from May 2005 to April 2006. Repeat CT scan head was performed on a routine basis at 48 hours of admission unless the patient deteriorated in which case it was done earlier. The sex ratio, age, mode of injury, presenting symptoms will be

studied. All the pre and post repeat scan radiological findings will be recorded with respect to appearance of new lesions, initial volume, and change in lesion or edema. The initial Glasgow Coma Score (GCS) at admission and the GCS at time of repeat scan will be noted. The change in operative management and the advantage of repeat scan in terms of prognosis of head injury patients when used routinely will be assessed. As per our methodology all those cases with significant mass lesion that required surgery, or cases that had intracranial pressure monitoring (ICP) insertion and those cases which were admitted more than 12 hours of injury were excluded from this study. Repeat scan was done as a routine basis after 48 hours of admission irrespective of the GCS score.

RESULTS

The total number of cases included in this study was 71 with males (48 cases, 67.6%) more common than females (23 cases, 32.4%). The most common age group was in the 20-40 years with 30 cases (42.2%), followed by the less than 20 years age group (29.5%) (Table-1). The age ranged from 12 years to 73 years.

The most common cause of injury was RTA (43 cases) with motorcycle injuries and fall from bus leading. Not wearing the helmet and trying to alight from a moving bus are the possible reasons. Fall was the second most

Table-1: Age groups

| Age group | N=71 | % |
|------------------------|------|------|
| <20 | 21 | 29.5 |
| 20-40 | 30 | 42.5 |
| 40-60 | 13 | 18.3 |
| >60 | 7 | 9.8 |
| Range 7 month-73 years | | |

common mode of injury. Domestic causes like fall in the toilet and stairs constituted the majority with 14 cases. Also fall from the buildings under construction and from the cliff and mountain ledges while gathering fodder are the other common mode of injury. Assault was the contributing cause in only 3 cases (Table-2). Associated injury was present in 26 cases comprising of distal limb fractures, skin abrasions and clavicular fracture. This could reflect the poor traffic law and order in developing countries and also the unplanned houses and conditions under which the majority of population lives.

Nausea and vomiting were the most common symptom in 41 (57.7%) cases, followed by headache in 31 (43.6%). ENT bleed, either from the nose or the ear was present in 24 cases (33.8%). A history of loss of consciousness (LOC) was present in 43 (60.4%) cases with the majority having LOC for less than six hours (49.2%). Early seizures defined as within one week of injury was present in 11 cases (15.4%) (Table- 3).

Contusions, including bilaterally and counter coup types, were the most common radiologic findings in 84.5% followed by extradural haematoma in 8.4% and pneumocephalus in 7.0% (Fig-1). Out of these the most common location for contusion was frontal (16 cases), followed by parietal (12 cases) and then bilateral contusions. The mean volume was 12 ml, 9 ml and 9 ml for frontal, parietal and temporal contusions respectively (average of 10ml). The volume calculation was done as per the ellipsoid formula of Length (AP diameter) x width x Height divided by 2 to give the final volume in



Fig. 1. CT scan showing Pneumocephalus

ml (Table-4). Repeat scan showed increase in volume of contusion in 31 cases (43.6%), no change in 28 cases (39.4%) and decrease in 12 cases (16.9%). The increase was mainly due to edema in 20 cases (28.2%) and due to actual increase in contusion in only 11 cases (15.5%) (Table-5). Of the repeat head CT scans, 68 (95.7%) were performed on a routine basis without neurologic deterioration whereas only 3 (4.2%) were performed for a change in Glasgow Coma Scale within 48 hours. One case of bilateral frontotemporal contusion with GCS of 6 on presentation deteriorated and expired (mortality of 2.0%). There was no increase in size of the extradural haematoma on the repeat scans.

The admission GCS was 13-15 in 32 cases (45.0%), 8-12 in 35 cases (50.0%) and only 4 cases with 5.0% had score less than 7. Thus the majority of cases were in the moderate group. Repeat score during the scan at 48 hours showed change from 32 (45.0%) to 41 (58.0%) cases for score of mild head injury and decrease from 35 (50%) to 29 (40%) for moderate head injury. This showed an

Table-2: Mode of injury

| Mode of injury | Number |
|----------------|--------|
| RTA-Motorcycle | 33 |
| RTA-Bus | 10 |
| Fall-stairs | 14 |
| cliff | 3 |
| building | 6 |
| tree | 2 |
| Assault | 3 |

Table-3: Symptoms present

| | | |
|-------------------|-----|--------|
| Headache | 31 | 43.6% |
| Vomiting/nausea | 41 | 57.7 % |
| Seizure | 11 | 15.4% |
| ENT bleed | 24 | 33.8% |
| LOC-<6hr | 35 | 49.2% |
| >6hr | 8 | 11.2% |
| Focal deficit | nil | |
| Associated injury | 26 | 36.6% |

Table-4: Admission and repeat scan findings

| Findings | Number N=71 | Initial volume (mean) | Repeat volume (mean) | Surgical intervention |
|------------------------|------------------|--------------------------|-------------------------|--------------------------|
| Contusion | <i>N=60(84%)</i> | | | |
| Frontal | 16 | 12 | 15 | 4 cases |
| Parietal | 12 | 9 | 10 | |
| Temporal | 10 | 9 | 11 | 1 case |
| Occipital | 3 | 4 | 4 | |
| Mixed: Fronto-Temporal | 8 | 5 | 5 | |
| Bilateral contusions | 11 | 9 | 11 | |
| EDH | 6 | 5 | 6 | |
| Pneumocephalus | 5 | 12 | 10 | |

clinical improvement to score of 13-15 in 13% of cases within 48 hours of admission .In reality only ten patients had score less than 12 (Table-6).

Change in the management plan by operative intervention was needed in 5 cases (7.0%). Of these 5 cases two had a GCS of 15, two had score of 10 and one had score of 12 on initial admission. Three out of these five had associated drop in GCS (60.0%) and the other had increase in contusion volume requiring intervention. Considering the location of the lesions 4 of them were in the frontal lobe and one in temporal (Fig-2).All of them improved after surgery.

DISCUSSION

With the easy availability and cheaper rates of the CT scan the rate at which the scans are being performed

seems to have increased in number. The exact time and the result of repeat scans is yet to be determined. Many of them have been studied on severe or blunt head injury. The oldest study to record repeat scan was in the study by French and Dublin in 1977 in which out of their series of 1000 head injury, cases 103 had repeat scans 31% of them undergoing surgical intervention.¹⁷ One of the earliest study dedicated to repeat scan by Roberson et al in 1979 concluded that repeat scan could be done on first post craniotomy day, on third day if no improvement and at 2-3 weeks and 3 months. They concluded by saying that repeat scan was of value in identifying post-traumatic hydrocephalus, delayed intracerebral hematomas, and intraventricular hemorrhage.¹⁵

Since that study the literature is also full of papers that support or disagree with serial CT scan in head injury

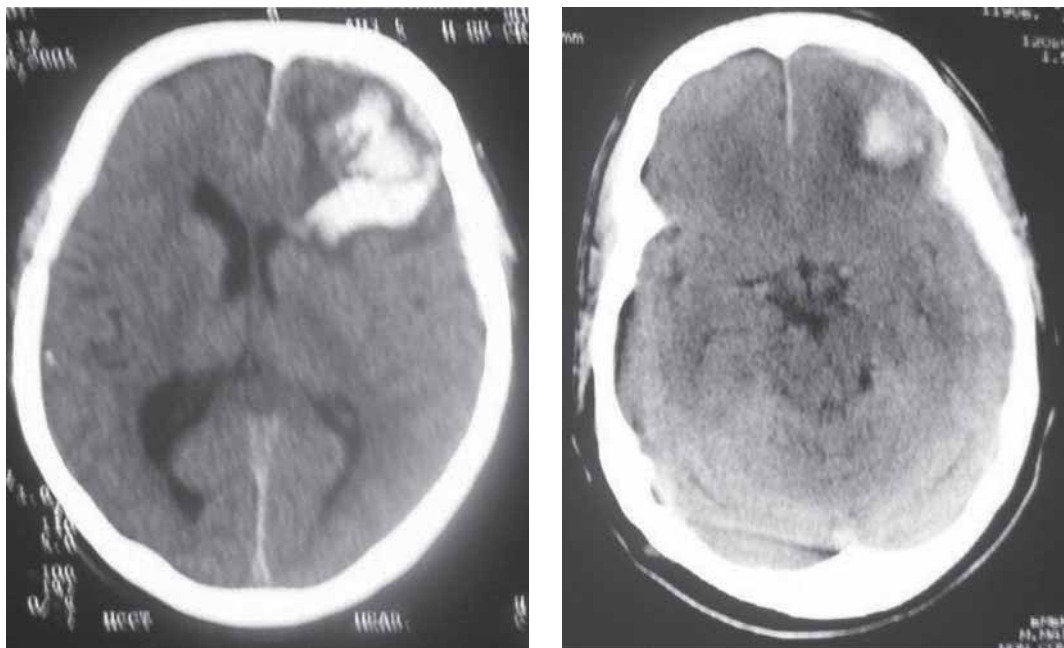


Fig. 2. Pre and post repeat scan of a surgical intervention case

Table-5: Repeat scan findings

| s.no | Result | | |
|------|---------------------------------|----|-------|
| 1 | No change | 28 | 39.4% |
| 2 | Increase of haematoma/contusion | 31 | 43.6% |
| 3 | Decrease | 12 | 16.9% |
| 4 | Increase edema/mass effect | 20 | 28.2% |
| 5 | Appearance of new lesions | 11 | 15.5% |

patients.⁹⁻¹² Those of them which support have called it standard practice to repeat scans at 1, 3, 7 days and 1 month or on days 3 and 7.^{1,4} Other studies have concluded that repeat scan should be done at 12 hours if the first scan was done within 3 hours of injury the reason being that a significant proportion of cases, especially if unconscious may be harboring intracranial lesions.⁷ The extent which this can be done in a developing country may be a significant restraint due to cost constraints. Good outcome was found in cases who did not have new lesions on repeat scan.¹

In this study we took 48 hours for repeat scan as the maximal changes occur within the same period and any advantage thereby provided by repeat scan would be most beneficial.³ The changes in repeat scan in this study was present in 43.6%, which was mainly due to edema (28.2%). This is in contrast to the study by Lobato *et al* which showed 23.6% new lesion development.³ The latter study also concludes to say that even after the initial scan a control scan must be taken for prognosticating findings. The role of steroids in traumatic head injury has always been controversial. The policy of this unit has been to start on steroids on tapering dose over a week in those cases which show increase edema on repeat scan. The advantage if any of using steroids needs another study for confirmation.

Contusions were the most common findings and the frontal lobe as the most common site. This would reflect direct injury or shearing effect on the skull base as the probable cause. The average volume was 10 ml. The volume calculation was done as per the formula given by Broderick *et al* and the modified version by Kwak.^{18,19} Studies in pediatric age groups have shown that the progression of injury was common if there was an initial 3 or more intracranial injury, mass effect, intraventricular hemorrhage or epidural haematoma.⁵ The study by Givner *et al* also reported that 26.0% of patients with initial GCS of 15 had progression injury.⁵ This would suggest that in children at least, even with a GCS of 15 they should be observed for at least 48 hours unless scan was done to rule out developing pathology. Repeat scan findings that needed surgery was found in only 7.0% of cases in this study and the majority of them were located

in the frontal lobe. This is in accordance with the study by Patel *et al* which showed that in conservatively managed patient's frontal intraparenchymal haematoma were more prone to failure.⁶ They also concluded that intracranial pressure monitoring was an integral part of nonoperative management. The demonstration that sequential CT scanning and ICP monitoring improve the final outcome would require a prospective randomized trial. It has also been stressed by other authors who have given ethical reason as one possible limiting factor in this type of study.⁸

Of the total cases of 31 in this study, which showed increased haematoma only 5 underwent surgery. Considering that only 7.0% of repeat scans needed operative intervention the role of routine repeat scan seems to be minimal. A similar study by Sifri *et al* on patients with minimal head injury with a bleed showed that out of 161 cases in their study only 4.0% needed intervention and none of those with repeat scan needed intervention. The Glasgow outcome scale in this study was favorable in 98.0% of cases. With this they concluded that repeat scan would have no benefit and thereby suggested multicenter trial to further validate it.¹³ Another study by Brown *et al*, who did a prospective study of 100 patients who underwent repeat scan showed that of the 68.0% who underwent repeat scan 90.0% was done on routine basis and only 10.0% due to a change in ICP, GCS, both pupil changes or new onset of headache. Of this 10.0% (9 cases) only 3 underwent intervention in the form of surgery in two and barbiturate coma in one case.¹⁴ In this study too, out of the 5 who underwent surgery 3 of them had a drop in GCS which by itself would suffice for operative intervention.

In the recent study by Fabbri *et al*, the authors have concluded with the interpretation that with neurosurgical consult by teleradiology system, repeat CT Scanning and transfer time 30-60 minutes to neurosurgical unit, it is not detrimental for subjects with initial non-neurosurgical lesions after mild-to-moderate head injury to be managed in the peripheral hospitals.¹⁶ This study has important implications in our country where the neurosurgical ward and intensive care are clogged with patients who could have been managed in a peripheral setting.

Table-6: The overall GCS change with regards to repeat scan and outcome

| GCS | Admission GCS | Repeat GCS @ 48 hrs | GCS improvement | Surgery |
|-------|---------------|---------------------|-----------------|----------------|
| 13-15 | 32 (45.0%) | 41 (57.7%) | 13% | 5 cases (7.0%) |
| 8-12 | 35 (49.2%) | 29 (40.8%) | | |
| 3-7 | 4 (5.6%) | 1 (1.4%) | | |

Thus to conclude this study routine use of repeat scan is of no cost benefit and offers no further advantage in patient management with stable mild to moderate head injury and is helpful if only there is some change in ICP or GCS. In borderline cases where the haematoma is more than 12 ml intracranial pressure monitoring is a useful adjunctive to clinical monitoring. We would suggest that in all haematoma less than 10 ml on initial scan with GCS of 15, or with larger lesions where the patient is improving there is no role for repeat scan unless there is clinical deterioration. This finding has important implications in developing countries where cost of the scan itself is a major economic burden on the patient family.

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