To Assess the Prevalence of Various Traumatic Brain Injuries (TBI) By Using CT as Imaging Tool a Research on Improvised Explosive Devices (IED) and Mines Blast Patients on Pakistan-Afghanistan Border a Retrospective Cohort Study

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Abstract

Background: The aim of the research is to explore the various types of brain injuries in patients with brain injuries caused by mines and Improvised Explosive Devices (IEDs) by using CT as an imaging modality. The motivation behind the study is the growing conflict intensity in Afghanistan where the radiologists in hospitals increased in numbers due to the fact that a one-hour turnaround was not sufficient. The coordination of imaging was becoming more difficult especially in a multiple casualty situation. Through this study, a statistic will be provided defining the brain injuries and the ratio of the injuries that have been identified using MDCT that will assist the health care providers to understand the number of brain injuries in each category that can be effectively assessed through CT imaging.

Methods: The study was conducted through mixed methodologies where the qualitative data was gathered through interview with the radiologists of the CMH hospital in Peshawar. The quantitative data was gathered through questionnaire which was filed by the radiologists. The data was further analyzed (i) parallel analysis, (ii) sequential analysis, and (iii) multilevel analysis which subsequently corresponds to the designs of joining the two methods described above and data synthesis. The data is analyzed in this research through specific data analysis techniques, which means that key word coding or thematic analysis will be conducted on the qualitative data, whereas cross-tabulations and regression modeling will be used to analyze quantitative data.

Result: The data result is shown through three main injuries that are (i) primary blast injury (ii) secondary blast injury and (iii) tertiary blast injury where the results were 7%, 53% and 47% respectively.

Conclusion: The study concluded the role of the CT imaging as significant in IED and mines blasts where it has been found that the radiography and Computed Tomography (CT) are the modalities of choice since images are acquired quickly and are able to readily detect fractures. In addition, it can also detect metallic and glass fragments that are embedded in the body and most importantly, the brain injuries. Thus, based on the above research the CT imaging is recommended at war zone and tertiary hospitals.

Introduction

Since the last decade, the rate of military conflicts has increased. It has highlighted the importance of battle casualties within an acute framework [1]. However, the battlefield radiology remains "old terms" where the first ever recorded used of radiology was taken in 1897 during the Greco-Turkish war [2]. This battlefield radiology has similar mechanism to the other radiology. It needs the knowledge of the injury mechanism and injury patterns with common patterns of the disease [1].

In addition to that blast, injuries may occur due to terror activities, mine blasts or explosions. Because of the explosions, these blast injuries are the reason for multi-system life threatening injuries found in both single and multiple victims [3]. According to [4] these events are complex
According to Tate, Simpson, and [5] the multi-detector CTs have been excessively used in the battlefield hospitals. Hospitals in Iraq and Afghanistan operated by UK have been using the MDCT. However, the images were reported remotely due to the decreased in number of staffing in the military radiology. The statistics shows that the authorized results were received by the clinicians within an hour using the remote reporting system in a day for a week. Since the increase in the conflict intensity in Afghanistan, the numbers of radiologists were increased due to the fact that one hour turnaround was not practically enough and the coordination of imaging was becoming more difficult especially in a multiple casualty situation.

The aim of the research is to explore the various types of brain injuries in patients injuries caused of mines and Improvised explosive devices by using CT as imaging modality.

In order to achieve the goal, the research will accomplish the following basic objectives:

1. To study and identify the types of blast injuries.
2. To assess various types of brain injuries in patients of mines and improvised explosive blast devices at a tertiary care hospital.
3. To assess the role of CT as an investigation of choice for such patients.

**Research Methodology**

This research is an experimental case study as it tries to understand the single unit draws a general idea. The case study is adopted due to its ability to give in depth analysis and assessment to the topic of IED and mines blast injuries in Pak-Afghanistan border. The case study will further elaborate the role of CT imaging in the CMH hospital in Peshawar.

**Selection and description of participants**

The research distributes close ended questionnaires to radiologist of Combined Military Hospital (CMH) in Peshawar, whereas the semi-structured interviews are taken from the emergency doctors present in the CMH, Peshawar.

**Result**

Most of the patients who were vitally stable and with injuries that are not severe were given first aid and transported to the hospital through vehicle ambulances. It usually takes 2 h to 3 h to reach the
The patients with severe blast injuries were transported through air ambulances. In the hospital, these patients were shifted to Surgical Immediate Treatment Center (ITC), where they were managed and relevant radiologic investigations were advised.

The initial evaluation is done by categorizing the data into three main injuries - (i) primary blast injury, (ii) secondary blast injury, and (iii) tertiary blast injury.

**Primary blast injury**

The primary blast injury includes the high order explosive with the overpressure blast wave which directly affects the air-filled organs and subsequent cavities such as the lung, ear and abdomen area [6]. The blast wave is increased through the surface reflection as observed in the explosion of closed spaces such as the bus, trains or the internal building area. The radiology or the primary blast injury aims at enteric and pulmonary barotraumas composed of pulmonary opacification important to prolix the pulmonary alveolar hemorrhage and subsequent pneumothorax (Figure 1). There are significant amount of pulmonary symptoms in the patients with substantial pulmonary blast injury that incorporates dyspnea, cyanosis and tachypnea. This is determined through mandatory chest confirmatory tests. If there is no sign of peritonitis, the clinical radiology role in evaluating the primary blast injury is only to determine the enteric injury manifestation such as the intraperitoneal free air. It has been found that the identification of the intraperitoneal free air is much effective when the Computerized Tomography is used compared to the conventional radiography.

The secondary blast injury is based on trauma due to the bomb fragments impact which means that it comprises the bomb causing along with the objects that are in the devices increasing the level of lethality such as nails, screws, bolts, pellets and nuts (Figure 2a, 2b). This category also includes the injuries that came from the debris outside the bomb which is propelled by the explosions. The penetrating trauma is contained in the secondary blast injury and also produces a blunt trauma. The penetration in any part of the body is sustained by the patients and has penetration fragments in several regions of the body.

The secondary blast injury radiological diagnosis assists in treatment prioritizing and identifying the injury that is life threatening. Intervention is required on a timely basis. For instance, the radiological images were used for the following:

1. FAST (Focused Abdominal Sonogram for trauma) scanning is done to rule out injuries to the visceras.
2. The patients were identified through the conventional X-ray with fragment injuries that may cause the intracavitary injury that needs more imaging with advanced methods.
3. The CT scan of thoraco abdominal is used to explain the injuries that are not apparent which include the hemodynamic sable patients having penetrations from blast fragments.

The patients that were injured by the fragments are also tested by...
CT scans that don’t need surgical therapy.

A 32 year old soldier had mine blast injury sustained on the head; CT axial shows metallic foreign body in the left parietal lobe with making a tract. There a large hemorrhage and some pneumocephalus on the ipsilateral side. This patient had overlying left parietal bone fracture with some other metallic fragment over the affected side.

A 20 yr old male student of IED blast suffered injuries to the head. A 3D volume rendering CT image shows a metallic body in the overlying right temporal bone. Another metallic body is seen penetrating through the left parietal bone.

Tertiary evaluation

The tertiary blast injury is due to the force of the blast wind where injuries involve trauma but can be defined as a penetrating trauma such as sharp object impalement. The focus was given to identifying the fractures through the radiological evaluations (Figure 3a, 3b), however, it incorporated the identifications of more injuries that are as follows:

1. The evaluation of thorax for pneumothorax or pulmonary contusion along with stigmata which is consistent with the subsequent acute thoracic aortic injury.
2. The radiography pelvic is utilized to determine or exclude the pelvic fractures morphology.

FAST is utilized to identify the intraperitoneal fluids presence in a patient that has blunt force trauma injury. In case of an explosive event, the fluid is considered to be the blood.

Demographics of the patients

The total number of patients observed was 500 male patients. The majority of patients (293) belonged to the age group of 25-35, and the second largest group of patients (173) belonged to 36 to 45 of age. Only 13 patients were 46 and up, and 21 patients were between the ages of 15 to 24.

Statistics of the three categories

The table below shows (Table 1) the observations of the patients that are distributed in three main categories of injuries. The characteristics of the injuries are defined above. The statistics of the patients are given in the following table however it should be noted that there were 35 patients (%) that did not fall in to one category only. There were 35 patients who belonged to two or three categories simultaneously. Therefore the statistics will not show 100% but will exceed the 100 percentage ratio.

Further subdivision of secondary blast injury

Once the patients are subdivided in to the above categories this research takes the observations from the secondary blast injury category only. The following section is based on the observation of the 265 patients belonging to the secondary blast injury category.

All of the patients from the secondary blast injury that have the brain injuries and are divided in the following four categories: (Table 2). The data also revealed that 73% of the patients that is 193 patients out of 265 patients of the secondary blast injury category had mild severity and 20% that is 53 patients were moderate however the rest of the patients have sever according to GCC. The 119 patients belonging to the penetration category is further divided in to two categories as follows (Figure 4 & Table 3).

Discussion

While having the interview with the radiologists, it was found that there are three main types of modalities that are being used in the CMH in Peshawar, near Pak-Afghan border equipped with the following:

1. The digital direct radiography portable machines where the images produced can be seen initially on the non-diagnostic built in screens are uploaded before to PACS for reports while FAST scanning is used for injuries to abdominal viscera.
2. In case an arterial injury is identified, the digital subtraction angiography is taken intra operatively. On the other hand, a repaired vessel can be used by the surgeon. The on table angiogram is formed with the use of an image intensifier.
3. There are two MDCT scanner based on Light speed 64-sice and GE healthcare that allows increased scanning when there are multiple casualties arriving at once. However, the patients who are stable are scanned only when the severely injured patients go through a trauma gram.

According to the radiologists, “the majority of the imaging occurs from 20 min to 60 min once the patient arrives at the hospital”. The initial read is taken by the consultant radiologists who determine the life threatening findings and the team of surgeons is notified. This takes only about a minute or two. CT imaging is used to exclude the
life threatening patients from the less critical injured patients who are in need of treatment at later stages.

The findings from this research stands corrected with the [6-8] research that have identified blast injuries into four main categories: (i) primary, (ii) secondary, (iii) tertiary, (iv) quaternary. This research has shown that CT imaging is the most effective and efficient technique for blast injuries (Tables 4-6).

**Key results**

The observation was based on 500 patients where the data analysis found that there were 35 (7%) patient belonging to the primary injuries, 265 (53%) belonged to secondary injuries and 233 (46.66%) belonged to tertiary injuries (Figure 5). There were 35 patients who belonged to two or three categories simultaneously. In secondary injuries, the patients with brain injuries were then further divided into penetration, concussion, contusion and others where the results shows the number of the patients as 119 patients, 79 patients and 53 patients respectively (Table 7).

Each category was again subdivided. Penetration was divided into two categories (i) Foreign Metallic Bodies or Bony fragments in Brain Tissue with Overlying Fractures and (ii) Foreign Metallic Bodies or Bony fragments in Brain Tissue without Fractures. The result for these two categories was 41 and 77 patients respectively.

On the other hand the concussion was divided into frontal lobe, Parietal Lobe/Temporal Lobe Injury, Occipital Lobe injury where the results were 21, 2 and 47 respectively. The subdivision of contusion was based on frontal lobe (2 patients), temporal parietal lobe (50 patients) and occipital lobe (1 patient) [9-15].

The study has concluded the role of the CT imaging as significant in the IED and mines blasts where it has been found that the radiography and Computed Tomography (CT) are the modalities of choice because images are acquired quickly and are able to readily detect fractures as well as metallic and glass fragments that are embedded in the body and most importantly the brain injuries. Thus based on the above research the CT imaging is recommended at war zone and tertiary hospitals due to the fact that there is a need to treat a huge number of injuries in a short period of time. The team of radiologists and clinicians are in need to understand the initial injuries done through the imaging that gives details of the long term consequences that has to managed by the clinicians [16-21].

The study has also concluded that the radiography is one of the most effective ways for the initial identification of the foreign bodies’ retention and also for the injury over view. On the other hand it’s concluded that the CT imaging is effective for the detailed anatomic measurement of the injuries. The study recommends that in the urgent situations the radiology resources like portable CT scanners should be used in war zones that will assist in swift evaluation and the management of the patients for life saving treatment.

**References**


