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Pattern and Outcome of Blunt Trauma Due to Tear Gas Canisters: A Study from Kashmir Valley

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Abstract

AIM: To study the pattern and outcome of blunt trauma due to tear gas canisters while controlling agitated mobs in Kashmir. *Methods*: A total of 82 patients with injuries caused by mechanical impact of tear gas canisters were studied in terms of anatomic site, severity and type of injury, treatment, and outcomes including morbidity and mortality. *Results*: Patients aged between 16 and 48 years. The most common sites of injury were the extremities (51.2%), abdomen (20.7%) and chest (18.2%). Seventy (52.63%) patients had minor or moderate injuries and were discharged within 12 hours. Twenty (24.3%) patients required an operative procedure. A total of three deaths (3.65%) were observed. *Conclusion*: Tear gas canisters can produce serious injuries by their direct impact that may even prove fatal. Injuries associated with tear gas canister should receive prompt management similar to that administered for severe blunt trauma and firearm-related injuries.

Keywords: Firearm Injuries; Tear Gas Shell; Tear Gas Canisters; Blunt Trauma; Riot Control Agents.

Introduction

Riot control agents are frequently used to control agitated mobs and for subduing barricaded criminals. They are highly potent sensory irritants of relatively low toxicity that produce dose and time-dependent acute site-specific effects. Collectively, these compounds have been referred to as 'harassing agents' or as lachrymators, and in common parlance they are known as 'tear gases'. Riot control agents are used in the form of sprays or as projectiles in the form of tear gas canisters [1].

Many reports of tear gas injuries have been published describing biological, physiological, and chemical/toxic effects of the gas on eyes, skin, respiratory and digestive tracts [2-4], but there are only few data published regarding the pattern, severity and outcome of injuries due to the mechanical impact of tear gas canister [5,6]. A persisting problem is the lack of medical recognition of the severity of injuries that can result from the direct impact of a tear gas canister, including, damage to the internal organs. To the best of our knowledge, this is the first study designed to evaluate the pattern and severity of the injuries caused by the mechanical impact of tear gas canisters and to find out the outcome in terms of morbidity and mortality.

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Material and Methods

This prospective study was conducted at three tertiary care hospitals in Kashmir, India. The data were obtained during the intermittent periods of civil unrest from June 2008 to December 2016. Thousands of patients were received in the Emergency Reception (ER), including those sustained firearm injuries (bullet injuries, tear gas canister injuries and pellet gunfire injuries), those who were injured by stone pelting and others by alleged beating by the security forces. Our study included only 82 patients who sustained tear gas canister injuries during the said period. Abstraction and information included the following: patient's

age, gender, anatomic location, severity of injury as per Abbreviated Injury Scale (AIS), diagnostic studies, treatment, and outcome including morbidity and mortality.

Upon arrival to the ER, patients were examined; primarily treated with intravenous fluids, a dose of anti-tetanus toxin, prophylactic intravenous antibiotics and local care of the contact burns. They also underwent the obligatory scans including plain radiographs [cervical spine, abdominal, pelvic and chest] and focused assessment with sonography in trauma (FAST). They were then sent either directly to the operating room, observation/ disaster ward, or for additional studies such as computed tomography, doppler scan, or extremity X-rays, according to their condition, assessment and diagnosis. Patients diagnosed to have minor or moderate injuries (AIS1 & AIS2) were discharged within 12 hours.

Statistical analysis was done by Graphpad Instat version 3.10 for Windows [Graphpad softwares Inc., San Diego, California, USA].

Results

During the study period, 82 patients sustained tear gas canister injuries. There were 80 males and 2 females. Patients aged between 16 and 48 years. The most common sites of injuries were the extremities (51.2%), abdomen (20.7%) and chest (18.2%) [Table 1].

Table 1: Anatomical Site of the Injury *(n=82)*

Resident	Number	Percentage
Head & Neck	8	9.7%
Extremities	42	51.2%
Chest	15	18.2%
Abdomen	17	20.7%

A total of forty-two patients had injury to the extremities (lower limbs 26, upper limbs 16). All the patients had varying degrees of bruises with or without superficial burns. Twenty-six patients had minor or moderate injuries (AIS1 and AIS2) and were discharged within 12 hours. Soft tissue hematoma was noticed in 18 patients. Ten patients (23.8%) sustained extremity fractures (humerus 2, tibia 2, fibula 2, radius 4, ulna 2, scaphoid 4); out of which six patients had involvement of more than one bone.

Seven patients had vascular injuries (brachial in 2, popliteal in 2, and radial/ulnar in 3). Associated skeletal trauma was present in all the patients with vascular injury; and nerve injury was seen in 3 (42.8%) patients. Primary repair of vascular injury was possible in only one patient and reverse saphenous vein grafts were used to salvage the limbs in all others. Nerve injury in one patient was repaired primarily, while in the rest of two patients injured nerves were only tagged for future identification. Post-operative complications included wound infection in 2 and thrombosis of the graft in another patient which could not be salvaged and an amputation was necessitated.

Out of 17 patients sustaining blunt abdominal impact, bruises with or without superficial burns over abdominal wall were found in 10 (58.8%) patients. Five patients required an exploratory laparotomy. The intra-operative findings and surgical procedures done are shown in Table 2. Two patients with gut perforations (small bowel and sigmoid) had an associated mesenteric tear with additional bladder wall hematoma in the patient with sigmoid injury. One patient with liver laceration had an associated gastric wall hematoma.

Table 2: Intra-operative findings at laparotomy and surgical procedure done

Operative Finding	Number of Patients	Surgical Procedure
Liver laceration	2	Repair
Splenic laceration	1	Splenectomy
Mesenteric tear†	2	Repair in 1 and RA in another
Small bowel perforation	1	Primary repair
Colon (Sigmoid)	1	Exteriorization of the affected bowel.
Bladder wall hematoma †	1	
Gastric wall hematoma *	1	

† Associated with bowel perforations; * Associated with Liver Laceration in 1 patient.

In the eight patients with head and neck trauma, one was brought dead. The clinical findings included depressed skull fractures in 4 (including one brought dead), cephalohematoma in 4, scalp lacerations in 2 and swollen unilateral maxillo-facial region in 1 patient. Only 3 patients were fully conscious at the time of admission. Non-contrast computed tomography documented large contusions in 2 (parieto-occipital in one and frontal in one), small multiple contusions in 2, concussion injury in one and maxillary fracture in another patient. Associated subdural hematoma (SDH) was noticed in two patients with contusions. One patient had isolated extradural hematoma (EDH).

Operative procedures included decompressive craniotomy in two and evacuation of large contusion and EDH in one each of the patients. Fixation of maxillary fractures was done in one patient. Two patients with large contusions died in the postoperative period. Recovery was complete in 2 and partial in one patient. Two patients continue to be in vegetative state.

In 15 patients sustaining chest trauma, bruises with or without superficial burns were seen in 8 and rib fractures in 6 (multiple in 2 and solitary in 4) patients. Chest Radiograph/CECT chest revealed pneumothorax in two and haemo-pneumothorax in one patient, who were managed with intercostal chest tube drainage. One of the patients with multiple rib fractures had a flail segment, but did not require a ventilatory support. None of the patients required a thoracotomy.

The AIS Score depicting the severity of injuries is shown in Table 3. Fifty (60.9%) patients were found to have minor or moderate injuries. A total of 20 (24.3%) patients required an operative procedure. Three deaths (3.65%) were observed in our series which were due to head injury in all the patients. One patient had vascular graft complication and required below knee amputation. Wound infection and atelectasis were the most common post-operative complications occurring in 4 (20%) and 2 (10%) patients respectively and were managed accordingly.

Table 3: Abbreviated Injury Scale Depicted severity of injuries at various sites.

AIS	Extremities	Abdomen	Head & Neck	Chest
1	16	10	0	9
2	10	2	1	2
3	8	2	2	3
4	7	2	1	1
5	1	1	3	0
6	0	0	1	0

Discussion

Riot control agents also have been referred to as irritants or irritating agents, and incapacitating agents or short-term incapacitants [1]. A number of firearms have been used to control violent mobs in Kashmir over the last two and a half decades. These include conventional bullets, rubber bullets, pellet firearms and other riot controlling agents including tear gas canisters [7]. Tear gas canisters are the commonest modality for crowd control and are assumed to have a lower mortality. Tear smoke canisters are all-weather projectiles, developed as powerful irritant gas generators for crowd dispersal. Since World War I, some 15 chemicals have been used worldwide as tear gas agents [1]. Four of these including w-chloroacetophenone (CN), o-chlorobenzylidene malononitrile (CS), 10-chloro-5, 10-dihydrophenarsazine, and a-bromo-a-tolunitrilehave been used extensively [2-4, 8].

The shell body of tear gas canister is made up of aluminium or heavy plastic and contains the irritant chemicals in pelletized form. The total weight of the canister is 275 + 5 gm, with an effective range of 135 + 10 m. It is launched by a single or a multi-barrel launcher which generate muzzle velocities of 50 m/s, producing a momentum of 13.5 – 14 Kg-m and a kinetic energy of 337.5 –350 J. The injury patterns that result from the direct impact of the tear gas canisters are due to the transfer of kinetic energy to the body that depends on the distance between the launcher and the victim. The gas produces temporary disablement of individuals by way of intense irritation of the mucous membranes and skin, while the direct impact can either produce minor trauma requiring local care in the emergency department or serious injuries, requiring admission to the hospital and frequently operative intervention. Burns due to tear gas canisters can result from either explosion near the victim, direct contact with hot canisters, or by the effect of the chemical powder inside the canisters [2].

In our series, the extremities were the most common site involved (51.2%). Lower limbs were more frequently injured (61.9%), probably due to their larger surface area. Fractures were, however, seen more often in the upper limbs (75% of fractures). This can be explained by the fact that the bones of the lower limbs are stronger, and there is a natural tendency of an individual to fend away the projectiles using one's upper limbs. Three of our patients with fractures were managed either by applying plaster caste or by closed reduction and external fixation; whereas 7 patients had associated vascular injuries were treated with open reduction and internal fixation. Peripheral vascular injuries were seen in 8.5% of our patients, which is in concordance with the data reported by Wani et al [6].

Seventeen (20.7%) of our patients sustained abdominal injury, of whom 5 (29.4%) required exploratory laparotomy for hemodynamic instability with free fluid in abdomen or radiological evidence of solid organ lacerations. These included the patients with peritoneal signs with or without free gas under diaphragm or a positive peritoneal tap. Three of our patients with blunt trauma had

radiological evidence of a Grade II or Grade III solid organ injury (Liver 2, Spleen 1), but were hemodynamically stable and were managed conservatively. Liver was the commonest solid organ injured and was seen in 4 (23.5%) patients, of whom 2 required exploratory laparotomy. Abdominal wall bruising was seen in 10 (58.8%) of patients, however, it was present in all the patients who required exploration or had a radiological evidence of internal injury. Internal organ injury results only when a sufficiently high amount of energy is transferred to the body, inevitably, resulting in bruising of the skin at the site of impact. Liver and spleen are the two most common organs injured following blunt abdominal trauma [9]. Similar pattern was observed in our study.

Serious injuries with occasional long-term functional deficit can result from tear gas shell injuries to skull. Head trauma due to tear gas canisters poses a grim outcome. Lethal head injury can result from tear-gas cartridge gunshots [10]. Head trauma was seen in 9.7% of our patients. A mortality rate of 37.5%was observed in patients sustaining tear shell canister injuries to head; apart from long term functional deficit in another 37.5%. Wani et al reported mortality in 20% and long term functional deficit in another 20% of their patients sustaining tear gas cartridge injuries to head, although their study included only 5 teenagers [5].

In our series, chest trauma was seen in 18.2%. All the patients were managed conservatively; except three (20%), who required an intercostal chest tube drainage. No cardiac injury was seen in our series.

Conclusion

Tear gas canister, though considered to be a non-lethal modality of controlling agitated mobs, can in fact produce serious injuries by direct impact especially to head that may even prove fatal . Injuries associated with tear gas canister should receive prompt management similar to that administered for severe blunt trauma and firearm-related injuries. Personnel using them might be better trained so that the people do not receive close hits. While the external injuries may seem trivial, if not appreciated for the potential internal injuries, there can be catastrophic results.

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Conflicts of Interests: Nil

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