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Suhail Rafiq<sup>1</sup>, Fahad Shafi<sup>2</sup>, Adil Sangeen<sup>1</sup>, Suhail Rehman<sup>1</sup>**Lung Injuries on Computerized Tomography Due to Pellet Gun**<sup>1</sup> Government Medical College, Srinagar, India<sup>2</sup> Sher-i-Kashmir Institute of Medical Sciences, Soura, India

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**Abstract.** Pellet gun used by law enforcement agencies have the potential to cause grievous or life threatening injuries as metallic projectiles fired at high speeds from pellet gun have potential to damage air containing organs like lungs which occupy a large portion of chest cavity and lie in close approximation to chest wall. Thoracic injury overall is the third most common cause of trauma following injury to the head and extremities.

**Objective.** The objective of this study was to evaluate lung pellet gun injuries in patients of a conflict zone by a so called non-lethal weapon.

**Methods.** The study was conducted in post graduate department of Radiodiagnosis and Imaging, Government Medical College, Srinagar Jammu and Kashmir. Our study was performed between the 6<sup>th</sup> January 2019 to the 22<sup>th</sup> May 2019. A total of 40 patients with pellet injuries were taken up for study.

Inclusion criteria were patients with pellet gun injuries without any immediate life threatening injury like head injury; patients willing to be part of study. Radiographs of all the patients were studied. Whenever there was suspicion of severe injury, CT scan was done. We obtained thin-section axial CT scans (0.625– 1.25 mm) with multiplanar reformation with an interval of 3-5 mm.

**Results.** All of the patients were males with most of patients in age group of 20 to 30 years.

About 14 patients out of 40 had lung injuries. The most common pattern of lung injury was pneumothorax followed by pulmonary hemorrhage.

In conclusion, a so called non-lethal pellet gun used by law enforcement agencies has the potential to cause lung injuries which can sometimes be lethal to life especially when fired from short distance.

**Keywords:** Lung trauma, Pellet, Pneumothorax, Riot control.

**Introduction**

Pellet gun used by law enforcement agencies have the potential to cause grievous or life threatening injuries as metallic projectiles fired at high speeds from pellet gun have potential to damage air containing organs like lungs which occupy a large portion of chest cavity and lie in close approximation to chest wall. Thoracic injury overall is the third most common cause of trauma following injury to the head and extremities. Thoracic trauma has a high morbidity and mortality, accounting for approximately 25% of trauma related deaths, second only to head trauma. Considered a “less-lethal” or “non-lethal” weapon, rubber or plastic-coated non-live rounds are used across the world to manage agitating mobs with the intention of causing no severe injury or death [1, 2]. However, studies across the world [1-4], including from Kashmir [4, 5], have repeatedly shown that the use of these “non-lethal” weapons often leads to serious injuries, permanent disability, and death. First used in response to the civil unrest in Northern Ireland in the 1970s, such “non-lethal” weapons have been documented to cause injuries and death [7]. In India, the paramilitary forces first used pellet guns during mob demonstrations in 2010 in Kashmir, which resulted in the death of 120 people; since then these guns have been used for crowd control in Kashmir [8]. During crowd control the police are recommended to aim at limbs while using non-powder firearms to cause minimum damage [9]. However, rules are not followed properly during crowd control causing lethal injuries

with what are commonly known as non-lethal weapons [10].

If used at closer ranges, the pellets do not have enough time to disperse and travel in a compact group which move at very high velocities, making them extremely harmful, almost behaving like hand gun bullets, enough to penetrate deep and cause severe damage to body tissues [11, 12]. The velocity and distance of the pellet can determine the nature of the injury.

**Objective of the study**

The objective of this study was to evaluate lung pellet gun injuries in patients of a conflict zone by a so called non-lethal weapon.

**Methods of the study**

The study was conducted in postgraduate department of Radiodiagnosis and Imaging, Government Medical College, Srinagar Jammu and Kashmir. Our study was conducted from the 6<sup>th</sup> of January 2019 to the 22<sup>th</sup> May 2019. A total of 40 patients with pellet injuries were taken up for study.

**Inclusion criteria**

Inclusion criteria were patients with pellet gun injuries without any immediate life threatening injury like head injury or major vessel injury; patients willing to be part of study.

All the patients were initially received in the accident and emergency (AE) Department of our Institute. Complete history was taken and examination of all the patients was done. Relevant investigations were ordered for all the patients.

Radiographs of all the patients were studied. Whenever there was suspicion of severe injury, CT scan was performed. We obtained thin-section axial CT scans (0.625– 1.25 mm) with multiplanar reformation with an interval of 3-5 mm.

**Results of the study**

40 patients with pellet injuries who met the inclusion criteria were included in this study. All of the patients were males (Table 1).

There was wide range in age of the patients (18 to 45 years) of patients with 22 out of 40 patients in age group of 20 to 30 years (Table 2).

About 14 patients out of 40 had lung injuries. The most common pattern of lung injury was pneumothorax in 9 patients, pulmonary hemorrhage in 7 patients seen as an area of ground

**Table 1. Gender based distribution of pellet victims**

	Male	Female
Total Pellet injuries	40	0

**Table 2. Categorization of Injured patients based on Age Groups**

Age Group In years	№ of Patients
10-20	3
20-30	22
30-40	13
40-50	2

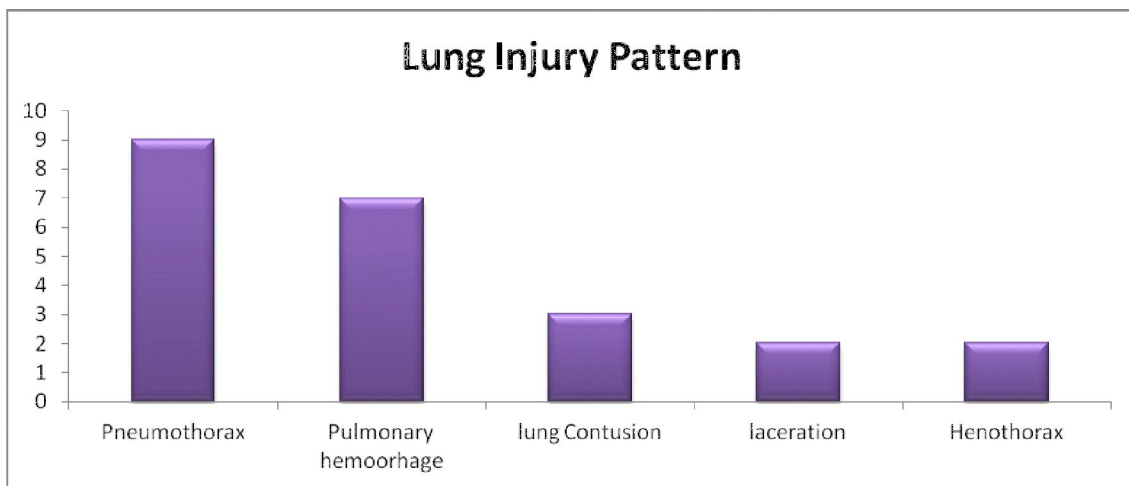
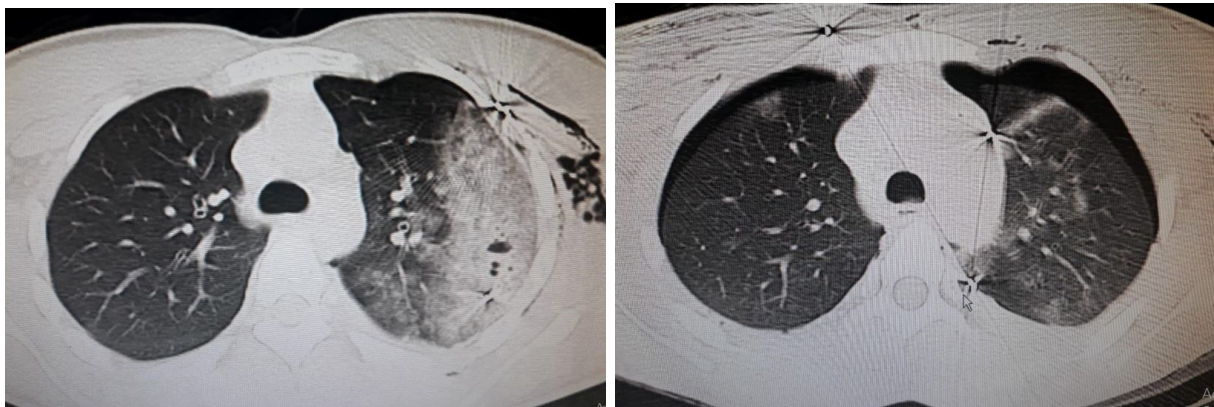


Fig. 1. Common patterns of lung injury in our study



A

B

Fig. 2. A) Axial CT image revealing lung contusion with pulmonary hemorrhage due to intrapulmonary pellet on left side with associated laceration. There is associated subcutaneous emphysema and pellet in anterior chest wall. B) Axial CT image revealing bilateral pneumothorax with multiple areas of ground glassing suggestive of pulmonary hemorrhage due to pellets. Intrapulmonary pellets are seen on left side with pellet in anterior chest wall



Fig. 3. A) Axial CT image reveals pellet in close relationship to pericardium. B) Axial CT image reveals intrapulmonary pellet on right side without associated lung injury

glassing around the pellet, lung contusion in 3 patients seen as an area of parenchymal opacification that do not respect the lobar boundaries and may manifest air bronchograms if the bronchioles are not filled with blood, laceration in 2 patients seen as an area of round or oval cavity that may be filled with air (pneumatocele), blood (haematocele or haematoma) or both, creating an air-fluid

level (haematopneumatocele) and hemothorax in 2 patients (Fig 1).

Most of these patients had combination of above injuries. The most common pattern was combination of pulmonary hemorrhage with pneumothorax in 5 patients (Fig 2). Patient with bilateral pneumothorax or with multiple contusions/areas

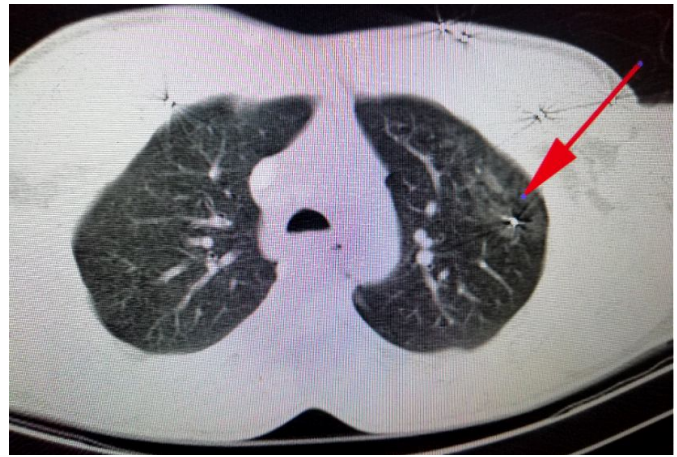


Fig 4. A) Axial CT image revealing left hemothorax due to intrapulmonary pellet, subcutaneous emphysema and anterior mediastinum location of pellet. B) Axial CT image revealing intrapulmonary pellet surrounded by area of pulmonary hemorrhage with associated anterior chest wall pellets

of pulmonary hemorrhage was taken as score of 1. About 9 patients amongst patients without lung injury had intrathoracic location of pellet with 5 patients having anterior mediastinum localization of pellet followed by lung parenchyma without any associated injury (Fig 3) (Fig 4). One patient had intra pericardial localization of pellet.

Survival of patients with lung injury was assessed. Out of 12 patients with lung injury, 1 died. One patient that expired had combination of injury pattern like laceration, contusion and pneumothorax.

### Discussion

According to our study, all of the patients were males of the age group 20-30 years. This can be explained by the fact that pellet guns are used by police/army to disperse off angry mobs which is mostly composed of young men. According to our study, Pneumothorax was the most common pattern of lung injury followed by pulmonary hemorrhage as compared to contusion in blunt trauma. This could be explained by the fact that pellets have very high kinetic energy associated with them leading to disruption of lung pleura interface and propagate through lung parenchyma with disruption at the capillary-alveolar interface. Pellets are too small to cause severe disruption of capillary-alveolar interface so contusion is slightly rarer pattern of injury due to pellets. Several factors determine the severity of injury they can cause. These factors include the tissue which it is going to hit, the distance from which it is hit and the intention with which it is hit<sup>[10]</sup>. A pellet gun cartridge once fired from the gun breaks into hundreds of metal pieces<sup>[10]</sup>. The injury pattern because of these pellets varies from minor skin abrasions to serious life threatening injuries like lung laceration and contusion. When fired from short distance, kinetic injury associated with pellet increases and pellets do not have enough time to disperse and travel in a compact group which move at very high velocities, making them extremely harmful, almost behaving like hand gun bullets, enough to penetrate deep and cause severe damage to body tissues.

### Conclusion

In conclusion, a so-called non-lethal pellet gun used by law enforcement agencies has the potential to cause lung injuries

which can sometimes be lethal to life especially when fired from short distance.

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