Gunshot injury to the colon in relation to wound ballistic: an experience from combat trauma in Ukraine

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Introduction

A gunshot wound to the colon is a frequent injury in armed conflicts, which is associated with severe trauma in combatants due to the increased damage properties of modern high-energy weapons. Such gunshot injuries may cause massive damage to soft tissue and internal organs, resulting in lethal outcomes or more prolonged treatment and rehabilitation time), as also seen in the ongoing russian-Ukrainian. Translational studies are important to investigate wound ballistics and to use such data for the clinical management of gunshot wounds.

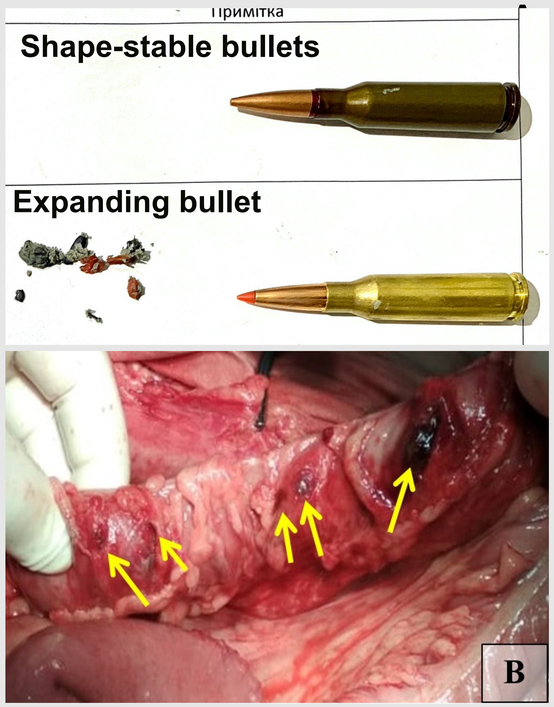


Figure 1. Illustration of the bullets and gunshot injury.

A. the shape stable bullets and expanding bullets (*e.g.* 5.45 V-max), which is forbidden by international war conventions, but in use by russian army. **B.** Colon injury due to V-max bullet with multiple perforations

Aim

to investigate and evaluate injury to the colon in combat patients as well as to determine specific features of the expanding bullet in transient structure simulations and animal models.

Material and Methods

Clinical analyses were performed on 112 male soldiers from Armed Forces of Ukraine with gunshot injury to the colon, wounded in East Ukraine between 2014 and 2020. Animal model constituted 20 pigs Svitlogorsk breed, and ANSYS Autodyn software was used for the simulation of the wound ballistics for 5.45mm V-max expanding bullets.

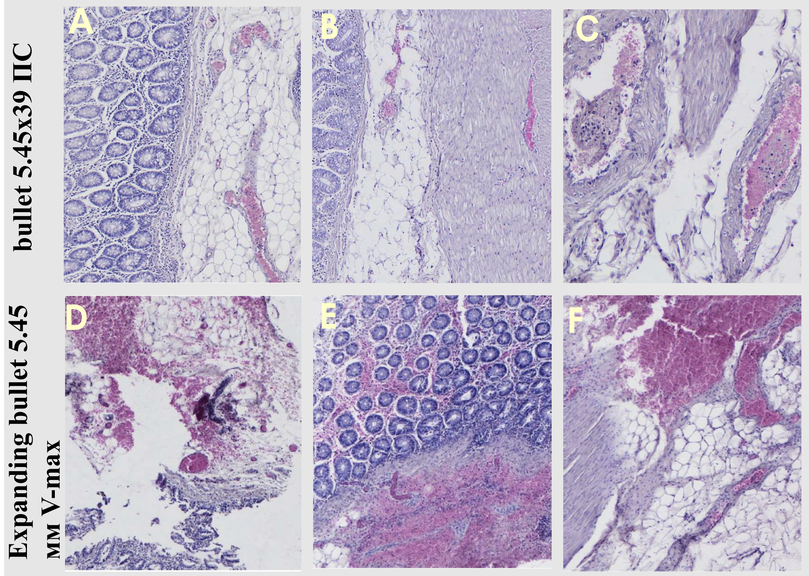


Figure 2. Microphotograph of the colon wall from the experiment on the pigs after the gunshot injury by AK-74 (distance 100m)

5 см from the inlet hole: **A** – Mild hyperemia of colon wall;
D – Defect of the colon wall and hemorrhage

15 cm from the inlet hole: **B** – Mild hyperemia of colon wall
E – hemorrhage of lamina propria and submucosa

20 cm from the inlet hole: **C** – Thrombosis of mesentery arteries
F – Hemorrhages in the serous membrane of the colon

Results

- A 43 (38.4%) patients were injured by the expanding bullets and 69 (61.6%) patients by shape-stable bullets.
- Shock stages III-IV were in 25 (58.1%) patients injured by the expanding vs. 17 (24.6%) patients injured by shape-stable bullets (p=0.0004).
- 18 (41.8%) patients injured by expanding bullets demonstrated 3-5 areas of colon penetration vs. none with shape-stable bullets injury (p=0.0001).

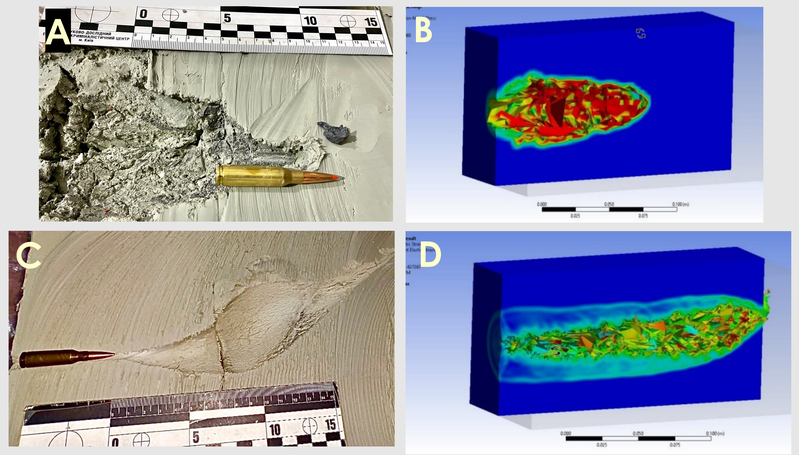


Figure 3. Model of passing a bullet through a block of ballistic plasticine.
A. Bullet **5.45x39 V-max (expanding)** after passing the ballistic plasticine
B. An energy distribution from the bullet **5.45x39 V-max,** t = 0.0005 sec
C. Bullet **5.45x39 PS (7N6M, shape-stable)** after passing the ballistic plasticine
D. An energy distribution from the bullet **5.45x39 PS (7N6M)**, t = 0.0005 sec

Conclusions

All patients should be suspected to have a expanding bullet injury in case of penetrating injury (absent exit wound) and careful revision of the abdomen must be performed to identify possible multiorgan injury due to severe damage by expanding bullets.

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