



## FEATURES OF LOCALIZATION FIREARM INJURIES FOR LARGE INTESTINE IN THE CONTEXT OF PROTECTION EQUIPMENT IMPROVEMENT (DATA OF JOINT FORCES OPERATION AT THE EAST OF UKRAINE 2014 - 2020 YY.)

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**Background:** Problem of gunshot injuries to the abdominal organs remains relevant. The proportion of that abdominal trauma during armed conflicts ranges from 3% to 12%. Colon injuries in the general structure of penetrating abdominal injuries account for 23%. According to the JFO data, colon injuries are found of 19,7% of the wounded.

The consequences of large intestine injuries are among the most unfavorable due to the difficulty of early diagnosis of this type of injury, which leads to a high incidence of complications such as peritonitis, sepsis, and multiple organ failure. As a result, there is a high mortality rate (7,14 %) and disability for this type of injury (16.4%).



Figure 1. Expansive bullet, extracted from colon after injury, during laparotomy (JFO, Ukraine)

**Materials:** We have processed data of 112 servicemens of the Armed Forces of Ukraine, which received gunshot abdominal trauma with the damage of colon during JFO in the East of Ukraine. The age of the wounded was in average 24 years, time from injury to admission in the hospital was near of 55 minutes.

The use of unconventional wounding projectiles, in particular, with expansive properties, which we regularly observe during JFO, leads to an increase in mortality, including with injury to the large intestine, due to wider contamination and larger volumes of damage. Therefore, data on injuries from conventional and expansive projectiles were analyzed separately.

In addition, we analyzed the X-ray data. During a medically indicated fluoroscopy, the volunteers (12 persons) were dressed in a ballistic vest and an X-ray was taken, followed by analysis of the protected and unprotected areas of the intestine.



Figure 2-3. X-ray investigation data

Figure 4. Localization rate for gunshot injuries of the colon (n=112)

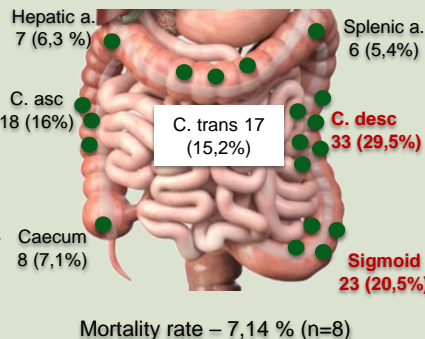


Table 1. Data about gunshot colon injury localization depending on type of bullet (JFO, Ukraine)

Localization	Conventional gunshot injuries of the colon (n=69)	Gunshot injuries of the colon with an expansive bullet (n = 43)
Cecum	6 (8,7%)	2 (4,6%)
Ascending colon	9 (13,1%)	9 (21%)
Hepatic angle	3 (4,4%)	4 (9,3%)
Transverse colon	10 (14,5%)	7 (16,2%)
Spleen angle	5 (7,2%)	1 (2,3%)
Descending colon	21 (30,4%)	12 (28 %)
Sigmoid colon	15 (21,7%)	8 (18,6 %)
<b>Total</b>	<b>69 (100%)</b>	<b>43 (100 %)</b>
<b>Mortality rate</b>	<b>3 (4,3%)</b>	<b>5 (11,6%)</b>

**Conclusion:** According to the results of our study, we found that the most common localizations for gunshot lesions are descending (29.5%) and sigmoid (20.5%) parts of the colon. An X-ray examination in the presence of a ballistic vest revealed that these sections are not protected by an armor plate. These data should be taken into account when providing assistance and calculations of forces and means and sanitary losses. Personal protective equipment needs to be further improved to protect these areas. Particular attention should be paid to gunshot wounds of the abdomen with damage to the colon with expansion bullets, where its fragments are multiple, which increases the area of injury, which leads to an increase in mortality by almost three times (from 4.3% to 11.7%) in compared with conventional bullets.

The authors whose names are listed immediately below certify that they have NO affiliations with or involvement in any organization or entity with any financial interest or non-financial interest in the subject matter or materials discussed in this manuscript. Author names: Kostiantyn Gumeniuk, Oksana Popova