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# HISTOPATHOLOGICAL CHARACTERISTICS OF PIG'S LIVER WOUNDS CAUSED BY AK UBMACHINE GUNS AND FN PISTOLS IN EXPERIMENT

LAM VAN LENH MD., MSc.

NGUYEN THUY LINH MD., MSc.

*Military Hospital 103*

Prof. NGUYEN TRUONG GIANG MD., Ph.D.

Assoc. Prof. NGUYEN MINH PHUONG MD., Ph.D.

*Vietnam Military Medical University*

Scientific reviewer:

(1) PHAM MANH CUONG MD., Ph.D.

(2) HO CHI THANH MD., Ph.D.

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**ABSTRACT:** *Experimental study, describing histopathological characteristics of liver wounds in experimental animals, caused by 7.62×39 mm bullets fired on AK submachine guns and 9×19 mm bullets fired on FN pistols.*

**Results:** *Central wound duct with entrance and out holes with lesions mainly liver parenchymal necrosis, blood clots in the wound ducts, and yellow gunsmoke dust. In the area of the wound duct wall, there was necrotic damage to liver tissue, mainly very heavy bleeding, and in the area of molecular damage, parenchymal hemorrhage of the liver was moderate to mild.*

**Conclusion:** *Histopathological characteristics of liver wounds in experimental animals, caused by bullets (AK guns and FN guns) have mainly necrosis of liver parenchyma in the wound duct; Areas of molecular damage and direct damage often have moderate hepatic parenchymal hemorrhage.*

**Keywords:** AK submachine gun, FN pistol, liver wound.

Responsible for the content: Assoc. Prof. Nguyen Minh Phuong MD., Ph.D., Email: phuongk21@gmail.com

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## 1. INTRODUCTION.

Firearm injury is a mechanical injury caused by a bullet escaping the barrel or the explosion of some hot weapons (bombs, mines, grenades, cannonballs...) to the body [1]. Firearm injuries are varied and complex. The injuries and marks left behind depend on many different factors, such as the type of weapon, the amount and type of explosives, the range, etc. Some of the most common types of lethal weapons in combat are straight bullets fired by pistols, rifles, machine guns, automatic guns, submachine guns. In addition, there are fragments of shells, mortars, grenades, bombs, mines, missiles, rockets [2]. Recent, in skirmishes in some countries and territories, or in tracking and the cracking-down on crime, some of the weapons that cause injuries can be small weapons, such as shotguns, rifles, homemade guns, grenades, mines...

The types of wounds caused by firearms were very diverse, many different types, depending on the type of weapon, ammunition, location, range... used by the enemy and the angle and direction

effects on the body [3], [2], [4]. Investigations showed that the survival rate of victims with traumatic brain injury was only 5-15%, and the mortality rate was up to 90-95% [3]. In patients suffering from Firearm injuries in the abdomen, the liver was the most commonly affected organ. The wounds caused by a gunshot into the liver created complex injuries, making it very difficult for surgeons to save the victims. In addition to the consequences of liver wounds, the rate of injuries to blood vessels and other organs was very high. The severe liver wounds in patients were demonstrated by the fact that 65% of patients present with shock on arrival to the emergency department and 13.5% of patients with unmeasurable blood pressure [5]. The main issues associated with the surgical management of severe liver injuries caused by a straight bullet revolve around major complications, bleeding, and infection. Both of these issues have received a lot of attention over the past several decades.

Liver injuries caused by a straight bullet were considered one of the dangerous wounds, more affecting the victim's life. Contributing to clarifying

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the level of danger to respond to the most effective management when an emergency, treating patients with liver injuries caused by firearms, we carried out this study to describe the histopathological characteristics of liver injuries in experimental animals caused by AK and FN gun bullets.

## **2. SUBJECTS AND METHODS OF THE STUDY.**

### **2.1. Subjects of the study:**

14 hybrid pigs met the requirements of experimental animals, each weighing approximately 50 kg. The experimental animals were divided into two groups:

- Group 1 consisted of 4 animals, were experimentally induced liver injuries with 9×19 mm bullets fired on FN pistols.

- Group 2 consisted of 10 animals, were experimentally induced liver injuries with 7.62×39 mm bullets fired on AK submachine guns.

### **2.2. Methods of the study:**

- Study design: descriptive, experimental.

- The shot process to create liver injuries in experimental animals:

- + Anesthesia of animals before firing to create injuries.

- + Performing shooting on AK guns at a distance of 50m and FN guns at a distance of 25m; bullets shot into the abdomen to create liver injuries in experimental animals.

- + After being shot, dissected animals revealed liver injuries.

- + Injured liver was collected, processed, and sampled for histopathological assessment.

- Research indices:

- + Describe the histopathological characteristics of the entrance and out holes with lesions

- + Describe histopathological characteristics of the area of molecular damage of lesions (3 cm from the wall of the wound duct).

- + Describe histopathological characteristics of the area of direct damage of the lesions (1.5 cm from the wall of the wound duct)

- Evaluate the level of liver tissue hemorrhage on histopathology.

- + Very heavy bleeding: laceration of medium-sized arteries and large veins with extensive hepatic parenchyma (>1/2 of the microscopic liver tissue sample area) with disseminated hemorrhage. The liver parenchyma was dissected by overflowing red blood cells, in some places the liver cells degenerated, necrotic.

- + Severe bleeding: laceration of small arteries and medium-sized veins with a large area of liver parenchyma (> 1/3 of the microscopic liver tissue sample area) was bleeding. The liver parenchyma was dissected by overflowing with red blood cells, in some places the liver cells degenerated.

- + Moderate hemorrhage: laceration of small veins: An area of liver parenchyma (< 1/3 of the microscopic liver tissue sample area) was bleeding, forming small hemorrhages. Vascular sinuses were dilated and had many red blood cells.

- + Mild bleeding: a laceration of the sinuses: A small area of liver parenchyma (< 1/3 of the microscopic liver tissue sample area) was bleeding with dilated sinuses containing many red blood cells.

- Data processing: entering and processing data on the software for biomedical statistics SPSS 22.0.

## **3. RESULTS OF THE STUDY.**

### **3.1. Histopathological characteristics of pig'S liver caused by 7.62×39 mm bullet fired on AK submachine gun:**

Macroscopic image of pig liver wounds due to 7.62×39 mm bullet fired on AK submachine gun (see Figure 1A). A microscopic lesion on wounds was detected:

- At the edge with entrance and out holes with lesions of the wound duct:

- + Crushing, necrosis of tissues: 10/10 wounds (100%).

- + Blood clots: 7/10 wounds (70.0%).

- + Having strange body: 4/10 wounds (40.0%).

- + Very heavy bleeding: 5/10 wounds (50.0%).

- In the areas of the wound duct wall:

- + Laceration of liver parenchyma: 5/10 wounds (50.0%).

- + Severe bleeding: 2/10 wounds (20.0%).

- + Average bleeding: 8/10 wounds (80.0%).

- In the areas of indirect damage:

- + Moderate bleeding: 3/10 wounds (30.0%).

- + Mild bleeding: 7/10 wounds (70.0%).

The entrance and exit margins of the hepatic wound duct with crushed lesions, liver tissue necrosis (10/10 wounds) and containing blood clots (7/10 wounds), with strange things (4/10 wounds).

Vessels with moderate and severe bleeding in the area of the wound duct wall with severe hemorrhagic lesions occurred in 2/10 cases; 5/10 cases had broken liver parenchyma. The Area of the molecular damage with moderate to mild bleeding.





Figure 1. Macroscopic image of pig liver wounds caused by 7.62×39 mm. bullets fired on AK submachine guns (A) and 9×19 mm bullets fired on FN pistols (B).

- Microscopic image of pig liver wounds:

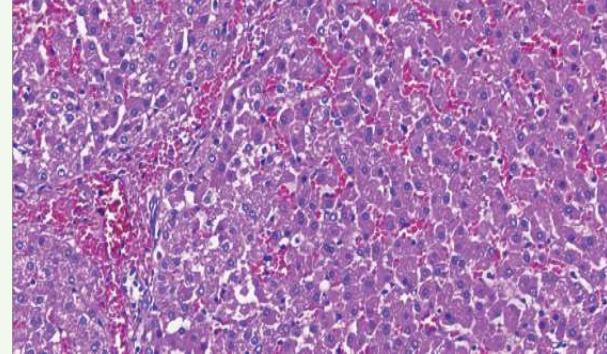
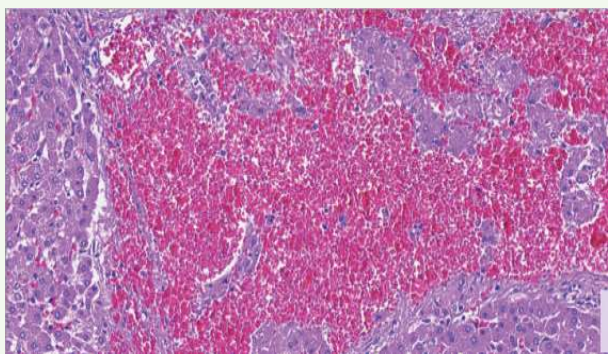
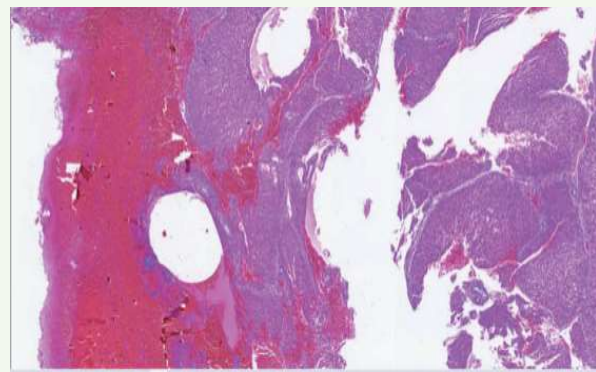
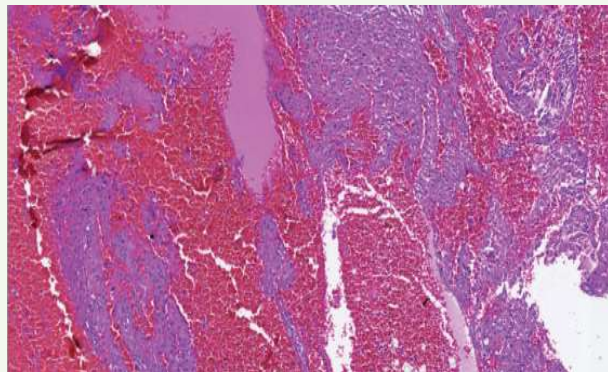


Figure 2. Microscopic image of pig liver wounds caused by 7.62×39 mm. bullets fired on AK submachine guns (A: An area at the edge of the entrance with crushing liver parenchyma, contains blood clots, the diffused hemorrhagic blood vessels were severe bleeding; B: An areas at the edge of the out holes with crushing liver parenchyma, had blood clots, the diffused hemorrhagic blood vessels were very heavy bleeding C: In the area of the wound duct wall with the diffused hemorrhagic blood vessels was moderate D: in the areas of molecular damage wound duct, hemorrhagic parenchyma of the liver was mild).

### 3.2. Histopathological characteristics of pig liver caused by 9×19 mm bullets fired on FN pistols:

- Macroscopic image of pig liver wounds caused by a 9×19 mm bullet fired on an FN pistol (see Figure 1B). Microscopic image of pig liver wounds include:

- At the edge with entrance and out holes of the central wound tube:

+ Crushing, necrosis of tissues: 4/4 wounds (100%).

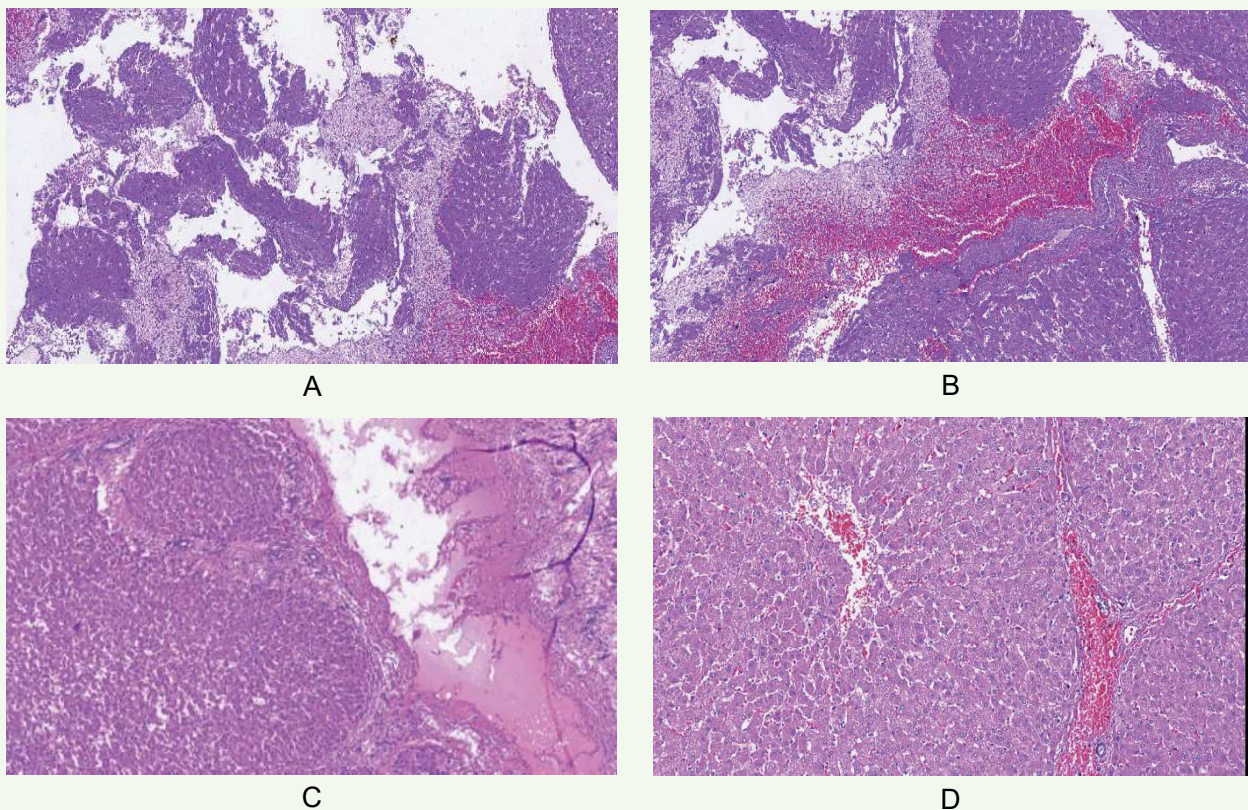
+ Blood clot: 4/4 wounds (100%).



- + Strange thing: 3/4 wounds (75.0%).
- + Very heavy bleeding: 4/4 wounds (100%).
- Area of wounds tube wall:
  - + Very heavy bleeding: 2/4 wounds (50.0%).
  - + Severe bleeding: 2/4 wounds (50.0%).
- Area of molecular damage wounds:
  - + Bleeding: 2/4 wounds (50.0%).
  - + Congestion: 2/4 wounds (50.0%).

Pig liver wound duct due to 9×19 mm bullets fired on FN pistol with a distant range of 25m, including central wound duct with entrance and out holes with lesions mainly liver parenchymal necrosis, of which 4/4 cases with blood clots in the wound ducts, 3/4 cases of strange body was yellow gunsmoke dust. In the area of the wound duct wall, there was necrotic damage to liver tissue, mainly very heavy bleeding, and in the area of molecular damage, parenchymal hemorrhage of the liver was moderate to mild.

- Microscopic image of pig liver wounds caused by a 9×19 mm bullet fired on an FN pistol:



*Figure3. Microscopic image of pig liver wounds caused by a 9×19 mm bullet fired on an FN pistol (A: An area at the edge of the entrance with crushing liver parenchyma, contains blood clots, the diffused hemorrhagic blood vessels were very heavy bleeding. B: An area at the edge of the out holes with crushing liver parenchyma, contains blood clots and the diffused hemorrhagic blood vessels were very heavy bleeding; C: In the area of the wound duct wall with the diffused hemorrhagic blood vessels was moderate D: in the area of molecular damage wound duct, hemorrhagic parenchyma of the liver was mild.*

#### 4. DICUSSION.

Firearms can deal direct or indirect damage. The direct damage was in the form of bullets that penetrate inside or the explosive power of landmines destroys the organization after detonation. The indirect damage was in the form of shrapnel from a weapon that shoots into the body

to deal damage (shrapnel, mines, explosive shells) [2], [6]. Infantry gun ammunition (sizes: 5.45 mm; 5.56 mm; 7.62 mm; 9 mm) fired from the barrels with a fast straight-line velocity and a relatively high rotational speed. The bullet penetrates deeply and destroys mainly in the direction of the body shot due to its high kinetic energy.

For histopathology of pig liver lesions caused by 7.62×39 mm bullets fired on AK submachine gun, we found that:

The liver wound duct with crushing lesions necrosis of liver tissues was found in 10/10 cases, had blood clots in 7/10 cases; the strange body was found in 4/10 cases. Blood vessels were damaged and caused heavy bleeding. In the area of the wound duct wall with severe bleeding wounds was found in 2/10 cases; with laceration of liver parenchyma was found in 5/10 cases and in the area of molecular damage, parenchymal hemorrhage of the liver was moderate to mild.

For histopathology of pig liver lesions caused by 9×19 mm bullets fired on FN pistols, we found that:

The liver wound duct was caused by 9×19 mm bullets fired on FN pistol with a range of 25m, including a central wound duct with entrance and out holes, the out holes were larger than the entrance holes with the main damage was liver parenchymal necrosis of which, 5/5 cases have blood clots in the wound ducts; 3/5 cases of the strange body was yellow gunsmoke dust. In the area of the wound duct wall, there was necrotic damage to liver tissue, mainly very heavy bleeding. In the area of molecular damage, parenchymal hemorrhage of the liver was moderate to mild.

Thus, histopathological lesions of experimental pig liver wounds, caused by AK submachine gun bullets (range 50m) and FN pistol (range 25m) have common characteristics: lesions mainly were liver parenchymal necrosis in the wound ducts. Areas of molecular damage and direct damage often have a moderate hepatic parenchymal hemorrhage.

Some documents have mentioned the classification table related to the prognosis of death caused by injuries to vital central organs. In terms of anatomical nature, for important organs such as the brain, heart, large vessels, and organs containing a lot of blood, and blood vessels, when having injuries, it will be very dangerous for life. Even a very small wound from a bullet with low kinetic energy can be deadly if a vital organ was damaged. The Red Cross classified such injuries as potentially fatal. However, if the risk of death was assessed according to the grade of the wound, a grade 1 wound can be just as deadly as a grade 3 wound, depending on the specific organ structure that had been damaged. For example, a spinal cord injury was more dangerous than a temporal brain injury; Wounds to the aorta were more lethal than parenchymal wounds [7].

Our study showed that experimentally liver wounds caused by bullets fired on AK submachine

guns and bullets fired on FN pistols have the most important damage, it was the bleeding state, of which the very heavy bleeding was in the area of the wound duct wall. In the area of molecular damage, although there was no liver parenchymal necrosis, but there was also moderate or mild bleeding due to the impact of the bullet kinetic energy. These were the points to note for the surgeon when handling liver injuries, pay attention to the bleeding in the areas of healthy tissue near the wound duct in the area of molecular damage.

## 5. CONCLUSION.

The experimental study, description of the histopathological characteristics of liver wounds in experimental pigs, caused by 7.62×39 mm bullets fired on AK submachine guns, with a range of 50m and 9×19 mm bullets fired on FN pistols, range of 25m, we found:

Central wound duct with entrance and out holes with the histopathological wounds mainly liver parenchymal necrosis, blood clots in the wound ducts, and yellow gunsmoke dust. In the area of the wound duct wall, there was necrotic damage to liver tissue, mainly very heavy bleeding, and in the area of molecular damage, parenchymal hemorrhage of the liver was moderate to mild.

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