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THE CONSEQUENCES OF GASEOUS PRESSURE IN BALLISTIC-INDUCED INJURIES – AN EXPERIMENTAL STUDY

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Abstract: ***Argument.*** Gunshot wounds are generally examined by assessing the aspect of the traumatic lesions aspect, represented by the destruction produced by the projectile. The injuries produced strictly by gas pressure have been less studied, and the model of a weapon that fires blind cartridges can provide valuable information in this direction.

Objective. The purpose of the present work is to analyze the mechanical action of gas pressure in gunshot injuries, distinct from primary injuries, produced by a projectile, in the situation of firing from a short distance, within the range of action of secondary factors of shooting.

Material and method. Two pig carcasses were used for the experiment, a gas revolver brand RÖHM RG89 cal. 9 mm. R, blindfolds, a Cannon brand camera and a LEICA microscope. Shootings were performed in different anatomical regions. Results: shots from a centimeter distance produce only epidermal lesions. Shots with glued barrel produce injuries that exceed the level of the skin when they are executed in an area of minimum resistance of the skin.

Conclusion. In shooting with blind cartridges, the destructive effect rarely exceeds the surface of the skin, it essentially depends on the shooting distance. In contact gunshot wounds, it is possible to exceed the limit of the dermis, these injuries becoming penetrating, especially at the abdominal level.

Keywords: blind cartridges effect, gaseous pressure in ballistic-induced injuries, shooting effects.

INTRODUCTION

Injuries caused by gunshots are divided, according to the classic treaties of legal medicine, into primary injuries, produced by projectiles and secondary injuries, produced by the additional shooting factors: gases, powder and metal particles, flame and smoke [1]. The additional factors act at a limited range, depending on the type of weapon and ammunition used. The effect of gases is twofold: mechanical and chemical. The mechanical action is manifested in the case of modern weapons up to a distance of 10 cm, with maximum intensity at 3 cm from the gun's muzzle [2].

The evaluation of the action of gas pressure, starting from their effects, is cited in the classic specialized literature, where the case of an actor is presented, who, having to play a scene of suicide by shooting, dies as a result of being shot with blind bullets, through lung perforation [3].

The gas pressure inside the barrel of a firearm at the time of firing can reach between 3000-4000 kgf/cm^2 [4], or, according to other authors, even over 4000 kgf/cm^2. At the level of the muzzle, the pressure reaches from 155 to 660 kgf/cm^2 [5], so that for a short period of time after the bullet leaves the barrel, it is additionally propelled by the gases, which - increase speed by 5-10 m/s [3].

It is very difficult to analyze the action of some of these isolated factors compared to the others, considering that the emerging lesions occur in no-time (at the same time?).

OBJECTIVES

The purpose of the present work is to analyze the mechanical action of gas pressure in gunshot

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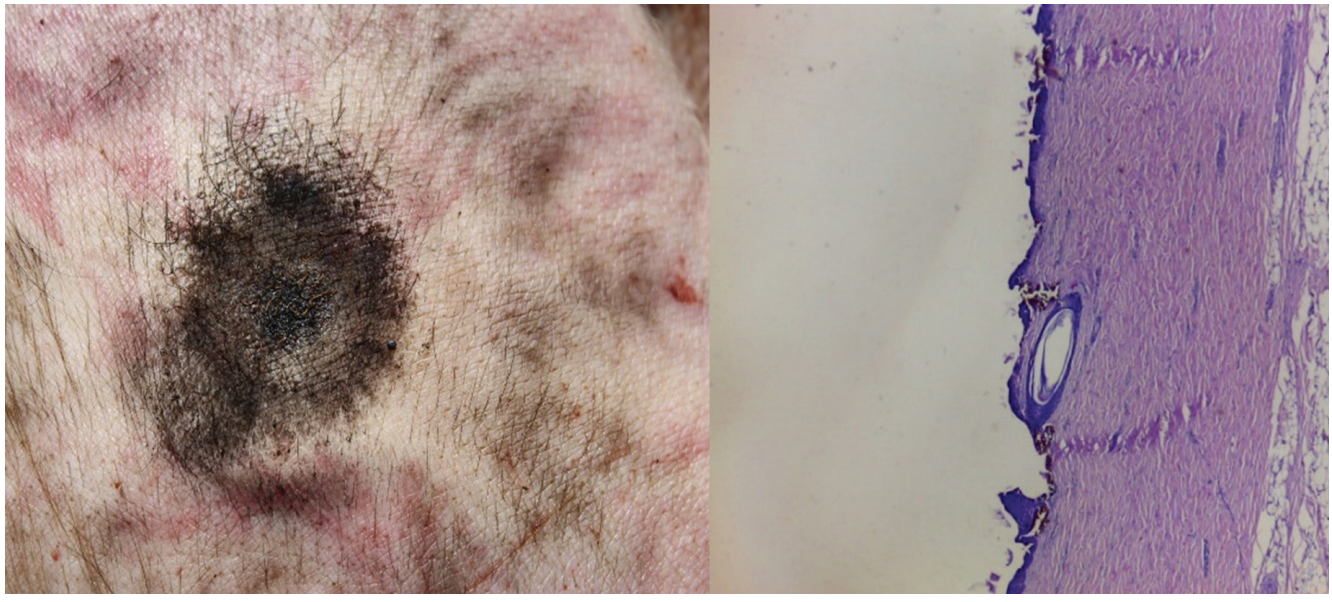

Figure 1. Two shots executed from 2 cm, at the level of the thigh of the lateral face, with macroscopic and microscopic aspects (4x objective).

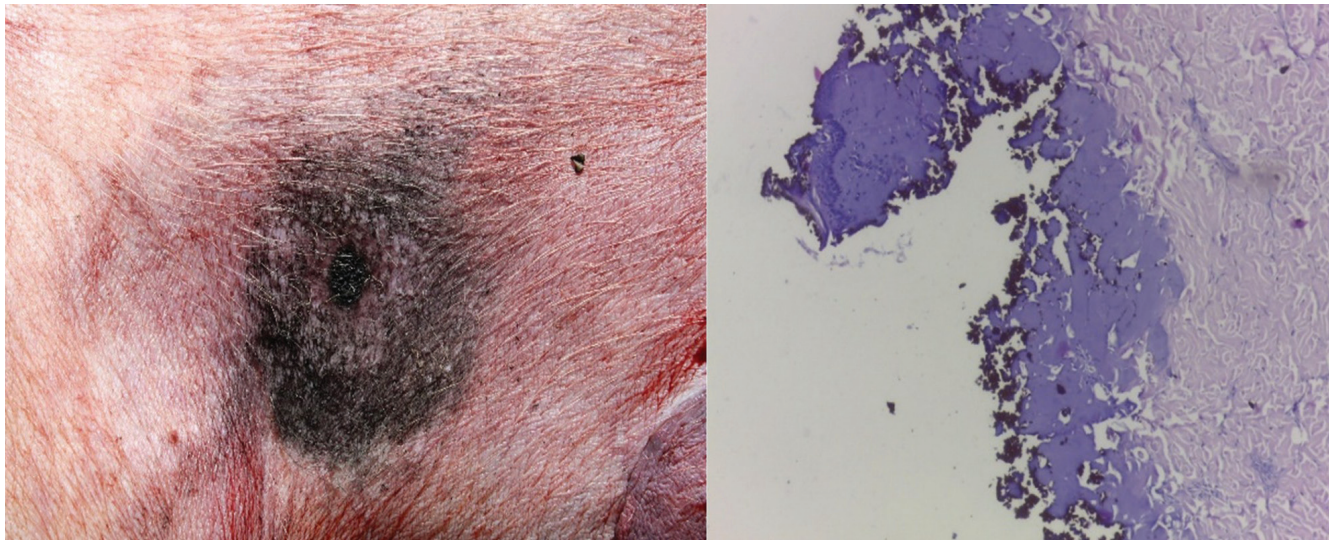

Figure 2. Two shots executed at the base of the left hemithorax respectively at the base of the right hemithorax at a shooting distance of 0.

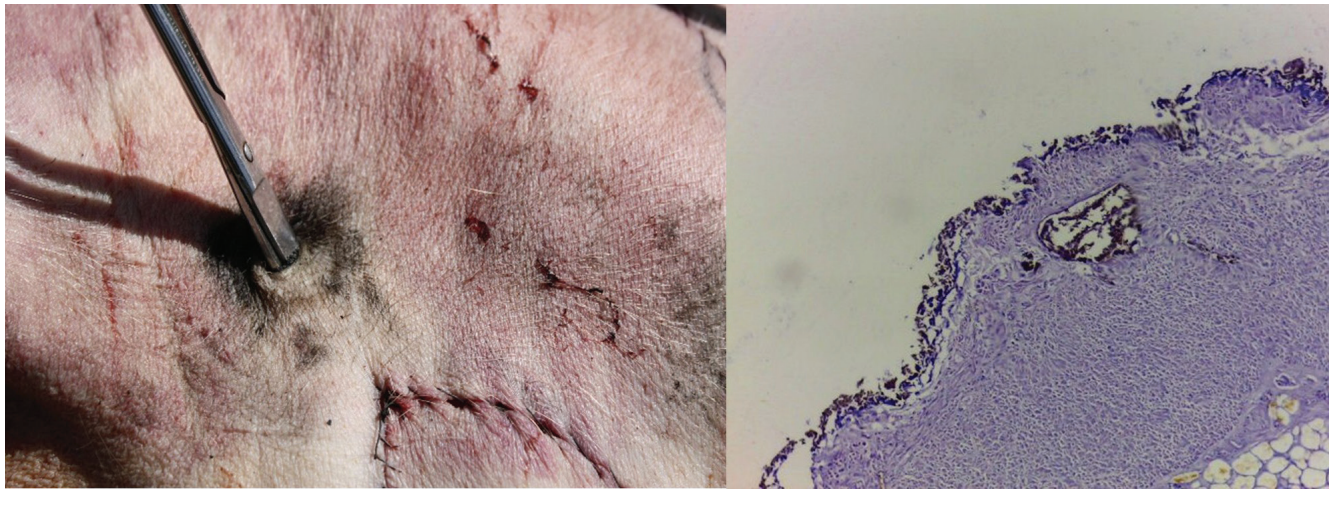

Figure 3. Two pulls with a taped tube at the level of the right and left abdominal flanks.

injuries, distinct from primary injuries, produced by a projectile, in the case of firing from a short distance, where the action of secondary factors is present.

MATERIAL AND METHOD

In order to carry out an experimental study, the following elements had to be selected: the type of ammunition, the type of weapon, the nature of the material in which the gun fire will be executed. Regarding the type of ammunition, in order to isolate the action of the secondary factors from the action of the projectile, two options were found at the theoretical level: the modification of the classic ammunition by removing the projectile - the variant abandoned for legal reasons - or the use of blind cartridges, from the category of noise, used by gas self-defense weapons, adopted option. The selection of the type of ammunition determined the choice of the weapon used, as being from the category of short weapons. A RÖHM RG89 cal revolver was used. 9 mm. R, gas self-defense weapon. Regarding the nature of the material in which the fire will be executed, for economic reasons the ballistic gel was abandoned, preferring the use of a biological target. Among the possible experimental animals, due to criteria such as size, anatomical similarities and availability, the use of pigs was chosen. In specialized literature, the use of pigs as experimental animals in the study of shootings is something frequently encountered [6, 7]. For reasons of research ethics, it was preferred to use two dead porcine corpses in authorized experiments carried out at the University of Agricultural Sciences and Veterinary Medicine Cluj-Napoca. The two animals had the onset of autolysis at the time of the start of the experiment. After the experiment, the corpses were returned to the University of Agricultural Sciences and Veterinary Medicine Cluj-Napoca for destruction by incineration. The use in experiments of animal corpses that died for reasons other than the respective experiment is not subject to the authorization of an ethics committee. The experiment took place in an authorized training ground. Photos were taken with the Canon EOS 450D camera and later the tissue samples were examined with a LEICA DM500 microscope with image capture.

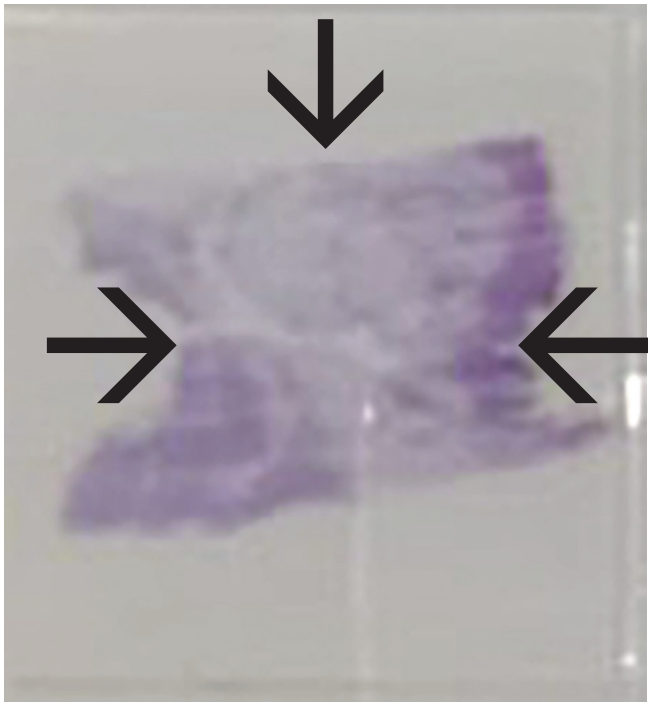

Figure 4. A shot executed at distance 0, in the anterior cervical region, right paratracheal.

RESULTS

A total of 15 gunshots were fired at different anatomical areas of the pig corpses, some from a distance of 2 cm, others from a distance of 1 cm and others from a distance of 0 (shooting with a glued barrel). We have selected the most relevant aspects:

1. Thus, the first two shots were executed from 2 cm, at the level of the thigh of the lateral face, obtaining the following macroscopic and microscopic aspects (Fig. 1):

a) Macroscopic aspect of the skin in the shot from 2 cm. in the thigh b) Microscopic aspect of the skin in the shot from 2 cm. in the thigh. 4x objective.

The macroscopic aspect of impregnation with soot and the microscopic one, in which the epidermis appears with a solution of superficial continuity and with thermal coagulation, are noteworthy.

2. The following 2 shots were executed at the base of the left hemithorax respectively at the base of the right hemithorax at a shooting distance of 0 (Fig. 2).

In the macroscopic image, impregnation with soot appears, in the microscopic one, the epidermis is gone, the dermis is torn, the burn appears more intense than in the previous image, and the impregnation with soot is obvious.

3. 2 pulls with a taped tube at the level of the right and left abdominal flanks (Fig. 3).

The macroscopic image shows the perforation of the abdominal wall, the microscopic allows the visualization of soot on the intestinal muscles.

4. 2 contact shootings to the skull showed only superficial burns and soot, plus denudation of the epidermis.

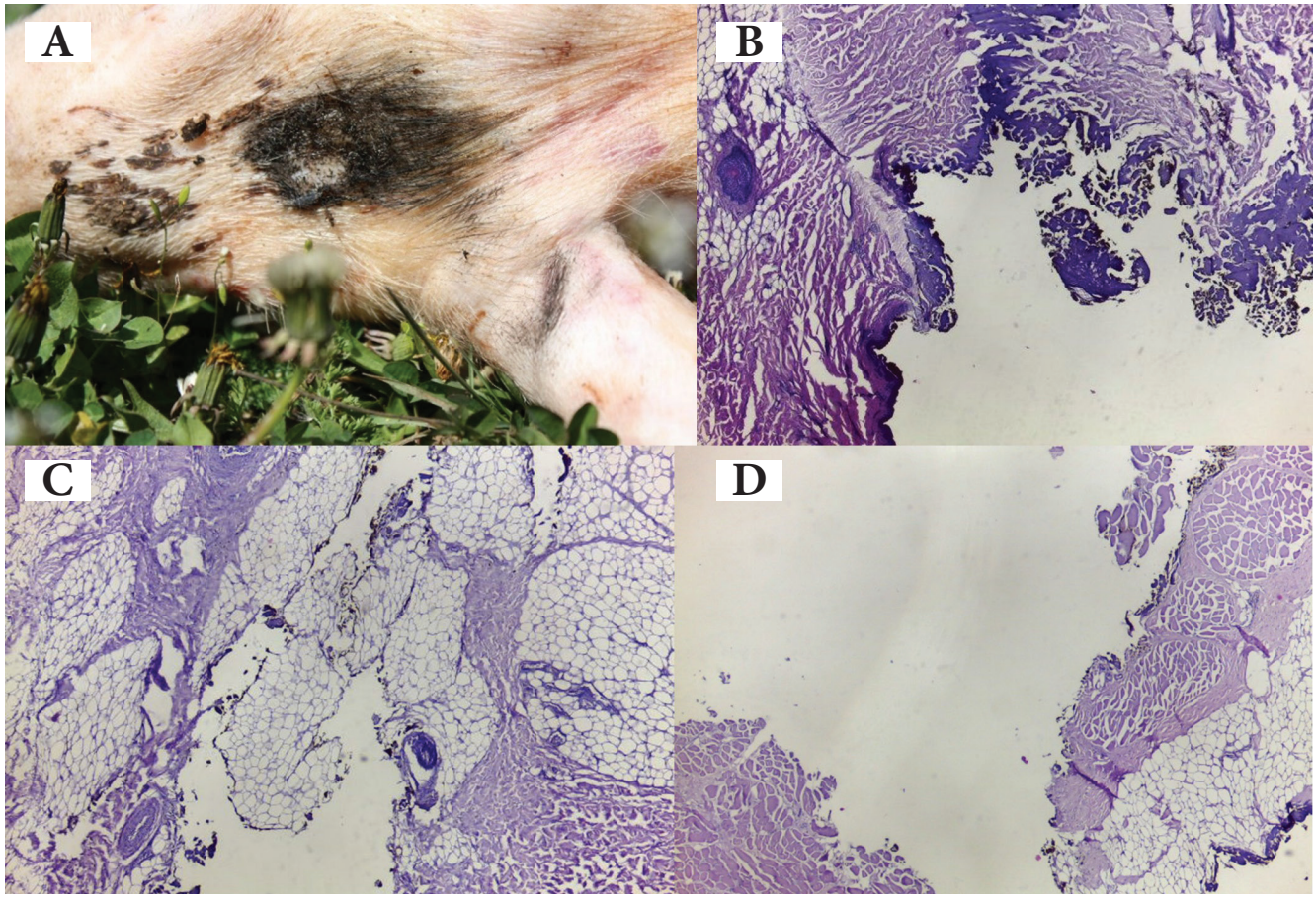

Figure 5. Shot at distance 0, anterior cervical region. a) macroscopic appearance. Traces of soot are evident; b) gas inlet, torn skin, thermal coagulation (burn); c) channel with soot; d) open tear "funnel" in the muscle tissue. 4x objective.

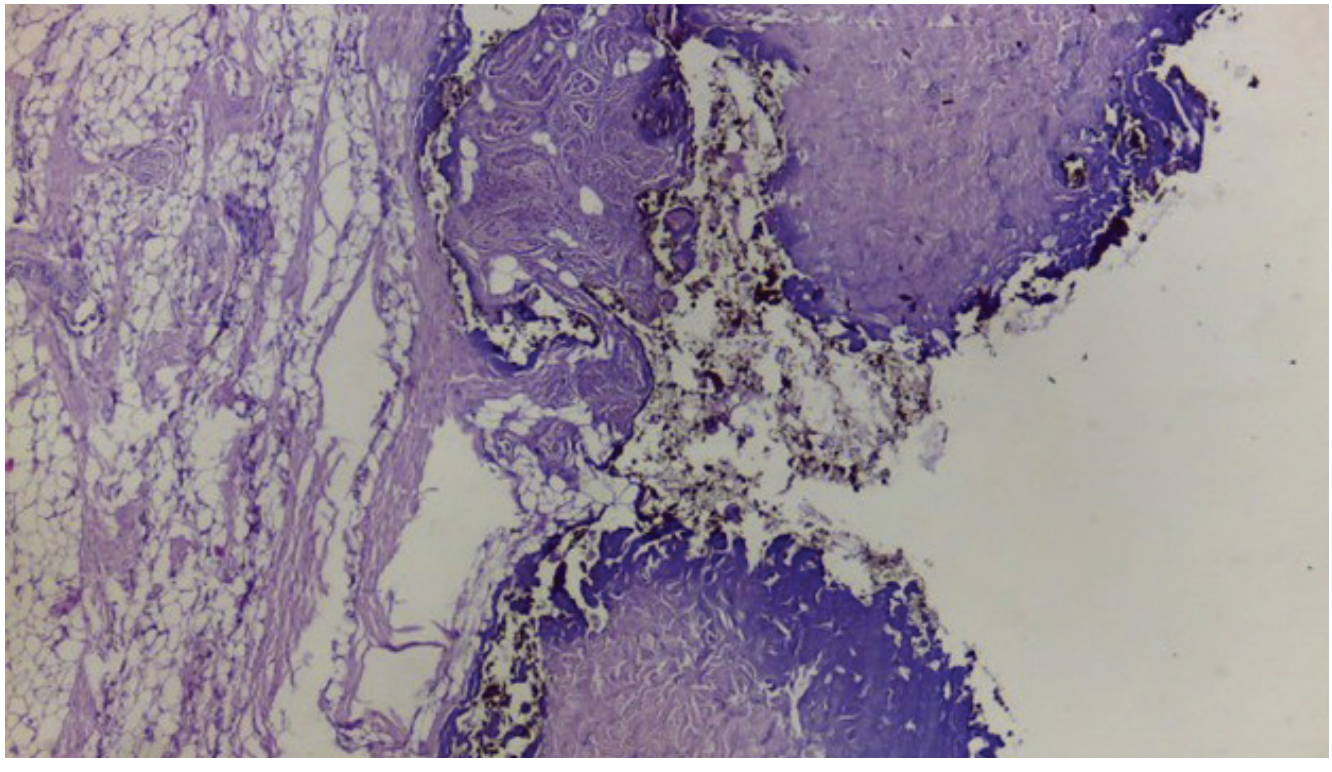

Figure 6. A fire executed in the abdominal flank at a distance of 0.

5. a shot executed at distance 0, in the anterior cervical region, right paratracheal (Fig. 4).

Macroscopic appearance of the slide, shot at distance 0, anterior cervical region. From right to left, the arrows indicate: the entrance hole with torn epidermis, the canal, "funnel" opening in the muscle tissue.

Shot at distance 0, anterior cervical region. a) macroscopic appearance. Traces of soot are evident; b) gas inlet, torn skin, thermal coagulation (burn); c) channel with soot; d) open tear "funnel" in the muscle tissue. 4x objective (Fig. 5).

6. A fire executed in the abdominal flank at a distance of 0 (Fig. 6).

Microscopic appearance: Entrance hole that branches out, reaching the level of the hypodermis. 4x objective. It is noticeable both in this image and in the previous ones that in the areas where only the gas pressure acts, not the flame, no thermal damage occurs. 4x objective.

7. The following 4 firings confirmed both macroscopically and microscopically the findings highlighted so far.

DISCUSSION

Shots from a centimeter distance produce - at least in the case of weapons with a reduced powder charge - impregnation of the tissues with soot and superficial continuity solutions of the epidermis, but do not achieve infra-dermal penetration.

Contact gunshot wounds lead to different effects, depending on the structure of the underlying tissue: if the tissue is predominantly loose, there are chances of producing penetrating wounds, otherwise, the excoriations are predominantly superficial.

The limits of the study were determined by the fact that we worked with pig corpses, which made the hemorrhagic infiltrate non-existent, and by the fact that the incipient autolysis that is also evident in the histopathology preparations could influence the structural resistance of the tissues.

Another limitation of the study was the fact that only one type of ammunition was tested, the specific self-defense type of the RÖHM RG89 cal revolver. 9 mm, which has a relatively small powder load, limited by the length of the cartridge, which, depending on the constructive type, deviates by a maximum of 1 mm from the figure of 16 mm.

CONCLUSIONS

1. Injuries produced by gas pressure can be evaluated starting from experiments made with self-defense weapons that use blank cartridges.

2. The characteristics of the lesions depend on the anatomical region concerned, and especially on the type of subjacent tissues: in an anatomical area with subjacent muscle or bone tissue, even contact gunshot wounds will be limited to the dermo-epidermal area, while in a region with adipose or lax subjacent tissue, there is also the possibility of producing penetrating wounds.

3. Injuries produced by firing from the centimeter level do not produce - in the case of the use of short weapons with blind cartridges - injuries that affect structures deeper than the dermis.

4. Thermal injuries do not appear superimposed on injuries produced by gas pressure.

Conflict of interest

The authors declare that they have no conflict of interest.

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