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Wounding Potential of the Russian AK-74 Assault Rifle

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The Russian contribution to the new generation of smaller caliber assault rifles is the AK-74, whose 5.61-mm (diameter), 3.4-gm (weight), 2.5-cm (length) aerodynamically shaped bullet has a muzzle velocity of 900 m/s. Our tests show that in living swine soft tissues and gelatin tissue simulant the AK-74's copper-plated steel jacket resists fragmentation or deformation. Since the bullet does not fragment, the tissue disruption surrounding the bullet pathway is limited to the stretching effect of temporary cavitation. We present evidence indicating that the energy used during temporary cavity formation causes limited permanent tissue disruption in the more elastic soft tissues (muscle, bowel wall, lung); the same insult in the relatively nonelastic liver, however, causes multiple fractures and massive permanent disruption. We conclude that the AK-74, despite its rather high velocity and marked tendency to yaw soon after penetration, causes relatively nondramatic wounds due to its nonfragmenting behavior.

One of the missions of the Wound Ballistics Laboratory at Letterman Army Institute of Research is to evaluate the wounds caused by various weapons. Recently, we tested the new Russian AK-74 Assault Rifle (Fig. 1). The bullet designed for the AK-74 (Fig. 2) was described in the July 1981 issue of the *American Rifleman* as follows:

> "The 53 gr. .221 diameter [the actual measurements before firing were 3.4 gm, 5.61 mm; although the diameter designated on the cartridge box was 5.45 mm] boattail bullet is .99" long, with a gilding-metal-clad steel jacket. Its unhardened, slightly boattailed and flatnosed steel core is surrounded by a thin lead envelope. The steel core is of a mild alloy similar to AISI 1010. Some of the lead is shoved ahead of the core or 'penetrator' but it does not fill the entire point of the bullet. The presence of the hollow cavity inside the nose of the full-patch bullet has led to considerable speculation as to whether it deforms upon striking the human body" (1).

The rate of rifling twist was reported as one revolution of the bullet traversing 195 mm of barrel with a velocity of approximately 900 m/s at the muzzle (1).

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The opinions or assertions contained herein are the private views of the authors and are not to be construed as official or as reflecting the views of the Department of the Army or the Department of Defense.

In conducting the research described in this report the investigators adhered to the *Guide for Laboratory Animal Facilities and Care* as promulgated by the Committee on the Guide for Laboratory Animal Resources, National Academy of Sciences, National Research Council.

Since the purpose of our test was to gather information that would aid surgeons treating wounds caused by this weapon, we fired five bullets into an anesthetized 70-kg swine to produce five potentially survivable wounds 1) upper hind limb (muscle); 2) other hind limb knee joint (bone, ligaments, muscle); 3) lower abdomen (soft tissue only); 4) upper abdomen (soft tissue, including liver); and 5) chest (involving lung but not mediastinum or heart)).

METHODS AND MATERIALS

All shots were fired from a 3-m range with the AK-74 Russian Assault Rifle (Fig. 1) held in a mechanical rest and fired remotely with a pneumatic piston. Bullet velocities were measured with a chronograph composed of two counters (Model 464T, Electronic Counters, Inc., Syosset, NY) connected in parallel (one serving check on the other). Impulses were gen-

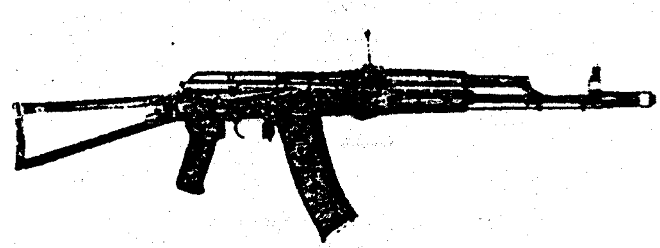

FIG. 1. The Russian AK-74 Assault Rifle.

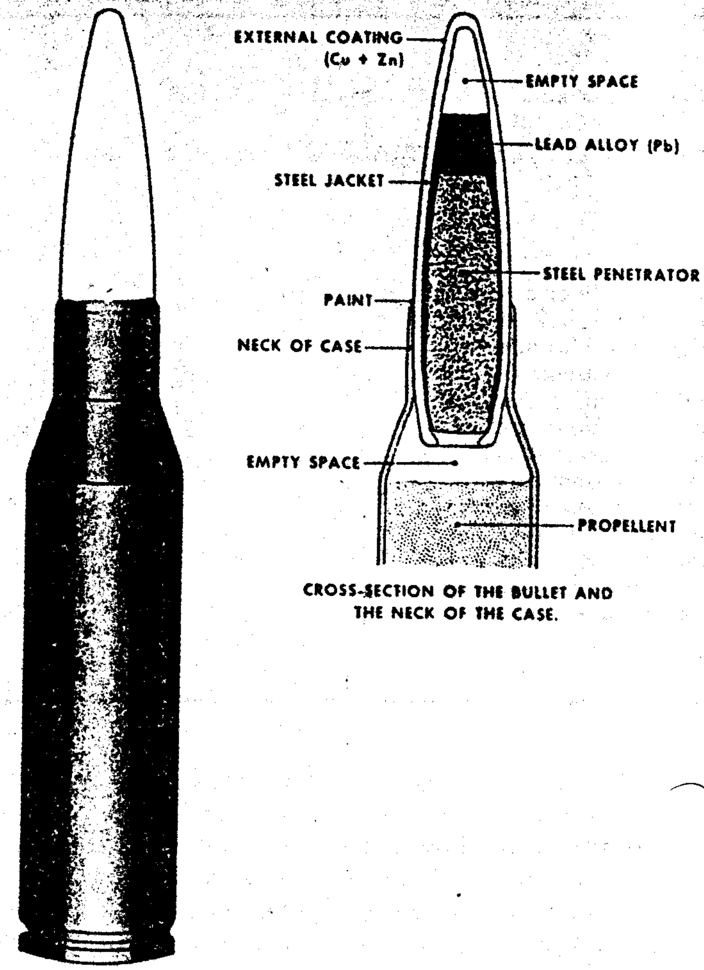

FIG. 2. Cross-section of the AK-74 bullet and diagram of the cartridge.

erated by the bullet breaking a circuit of fine metal foil printed on thin paper. Screens were spaced 50 cm apart and both were placed midway between the rifle muzzle and target.

Three shots (shots one, two, and three, Table I) were made into 10% gelatin tissue simulant which was molded into 20 × 22 × 47-cm blocks and kept at 4°C. Two blocks were placed against each other end to end to insure capturing the entire bullet track and to determine bullet penetration. This tissue simulant has approximately the same resistance to bullet penetration as living swine muscle (2).

Five shots (Table I) were made into a 70-kg swine anesthetized with 0.8% endotracheal halothane. Each site is listed in Table I. The swine was restrained in the dorsal position. The five wounds were made within 20 minutes. Shots four, five, and six were made transversely with the bullet tract approximately 90° to the long axis of the swine's body. For shot four, the left hind limb was placed in the extended position and the shot was fired through the thick proximal portion (muscle) avoiding bone. Shot five was placed through the right knee joint of the right leg in the extended position after the left leg had been released. The right leg was released and shot six was placed through the lower abdomen. The table holding the swine was turned 30° for shot seven so that the bullet would enter inferior to the left costal margin and penetrate the central part of the liver. For shot eight, the swine was placed in a lateral position on the table so that the left lung but not the mediastinal structures would be struck by the bullet. In all of the swine shots a block of gelatin was placed against the animal at the predicted site of bullet exit (Fig. 3).

After shot eight, the swine was killed with an overdose of intravenous pentobarbital sodium. Wound tracts were then dissected within 2 hours. The bullets were recovered from the adjacent gelatin. They were inspected and weighed to determine deformity and/or fragmentation. The penetration into gelatin was then added to the measured thickness of the perforated swine wound to determine total penetration of the shot.

RESULTS

None of the seven bullets which struck animal soft tissue or gelatin deformed or fragmented; the bullet jacket surrounding the hollow tip did separate in the shot through the knee joint. Numerical results of the shots are listed in Table I. All of the bullets had passed

TABLE I

Shot No.	Velocity (m/s)	Target	Penetration (cm) Partial	Penetration (cm) Total	Weight of Recovered Bullet (gm)	Size of Hole and Comments
1	876	Gelatin		47 plus	3.4	Bullet exited top of first block
2	911	Gelatin		49 plus		Bullet exited side of first block, not recovered
3	919	Gelatin		56	3.4	Radial splits in few yaw cycle 11-cm diameter, maximum permanent cavity is 2.5 × 0.6 cm
4	917	Pig leg	28	53*	3.4	Exit showed 3-cm skin split in addition to 2.5 cm slit-like bullet hole
		Gelatin	25			
5	915	Pig knee joint	24	44*	3.2	Severe bony fragmentation but contained inside knee joint
		Gelatin	20			
6	911	Pig lower abdomen	44	55*	3.4	0.6-cm round exit hole in skin, multiple bowel perforations from round 0.6 cm to oblong 0.6 × 2.5 cm
		Gelatin	11			
7	905	Pig upper abdomen, including liver		56	3.4	Liver massively lacerated and pulped, disruption 12–13 cm diameter
8	893	Pig chest	38	51*	3.1	2.7 × 0.6-cm slit-like hole through lung, fractured rib on exit
		Gelatin	13			

* Total penetration through tissue and tissue simulant (gelatin).

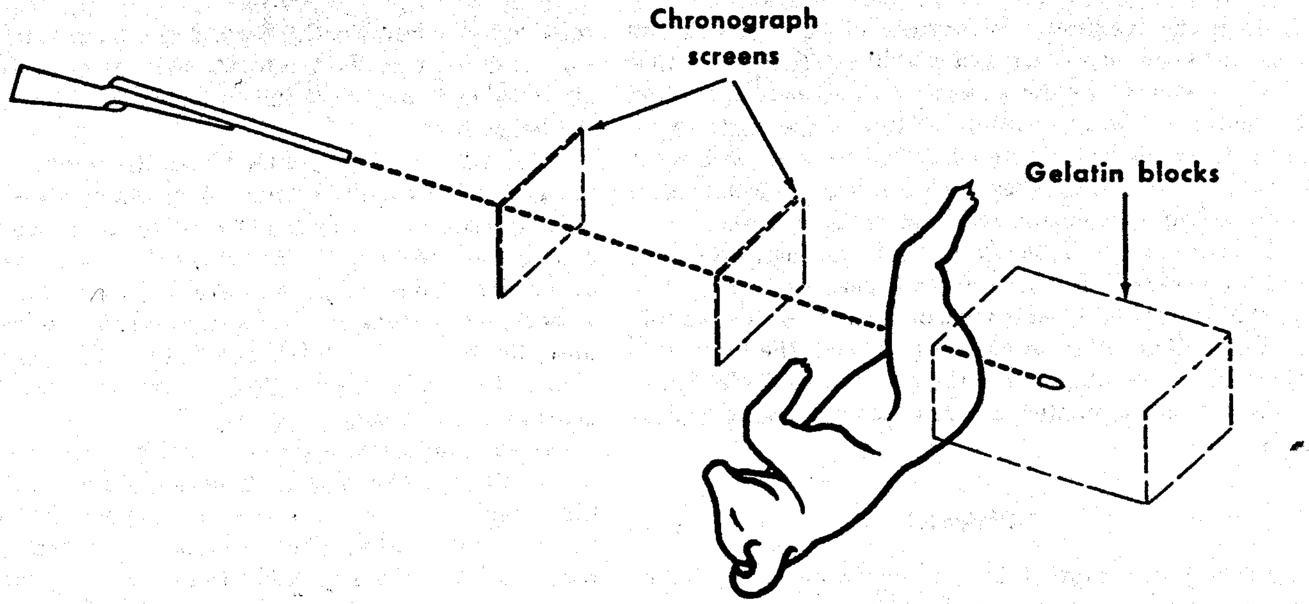

FIG. 3. Diagram showing use of large gelatin block as bullet trap.

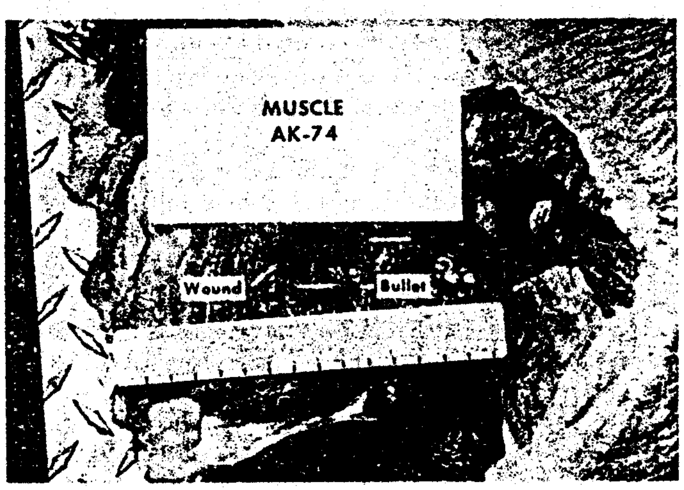

FIG. 4. AK-74 wound in swine leg muscle—recovered fired bullet was placed beside the wound for comparison.

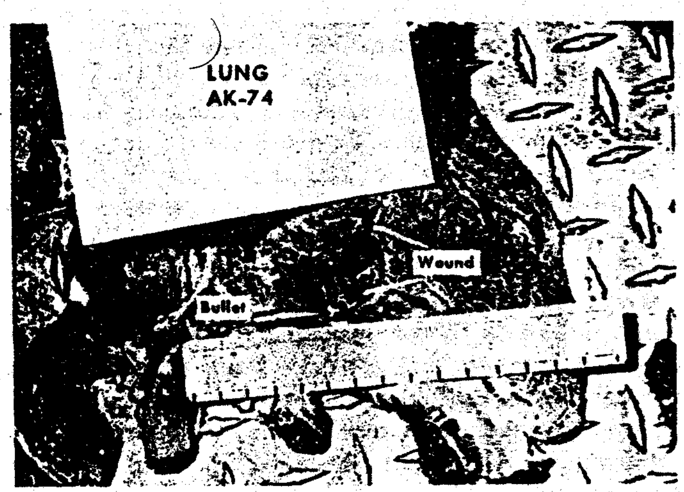

FIG. 6. AK-74 wound in lung—recovered fired bullet was placed beside the wound for comparison.

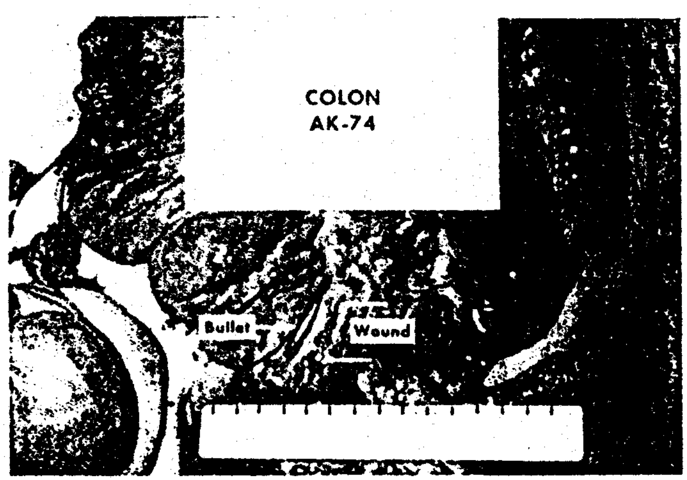

FIG. 5. AK-74 wound in colon—recovered fired bullet was placed beside the wound for comparison.

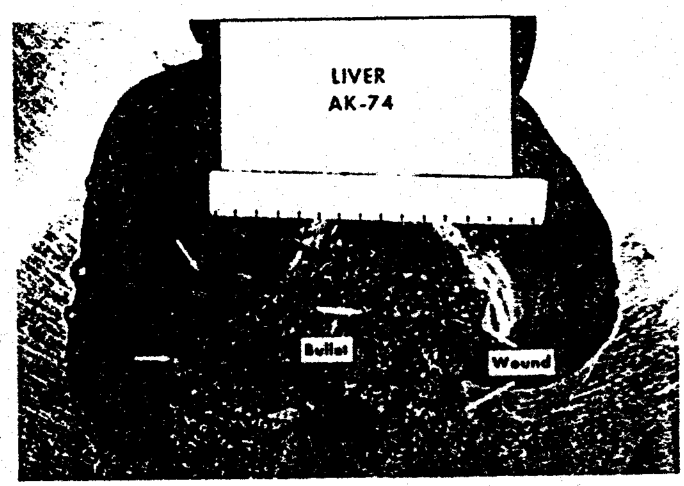

FIG. 7. AK-74 wound in liver—recovered fired bullet was placed in the center of the massive disruption for comparison.

through the maximum 90 degrees of yaw (yaw is the angle between bullet long axis and line of flight—a bullet at 90° of yaw is traveling sideways) and were recovered in the base-forward position. In five of the eight shots, the bullet's penetration line deviated 40 to 60° as it went through yaw. The yaw began within 5 cm of penetration and reached a maximum at 18 cm of penetration.

The permanent tissue disruption in muscle, bowel wall, and lung (Figs. 4–6) varied from a round 0.6-cm hole to an oblong or slit-like hole measuring 2.7 × 0.6 cm (Table I). Tissue disruption in the shot through the liver (Fig. 7) was massive compared to the other shots. This wound measured approximately 13 cm in diameter at its widest point.

COMMENT

Recently we showed that a nonfragmenting bullet causes rather minimal permanent tissue disruption in the leg muscle of living anesthetized swine in contrast to the massive disruption caused by fragmenting bullets (2). The results of our present test indicate that the AK-74 bullet acts in the manner expected of full-metal-cased military ammunition—it does not deform or fragment when striking soft tissues. Even full metal cased military bullets can deform and/or fragment if they strike bone and, in such instances, they can cause massive tissue disruption similar to wounds created by fragmenting bullets.

The tissue disruption caused by the nonfragmenting bullet is limited to two mechanisms. First, the bullet must make a hole in the tissues large enough to pass through; it does this by crushing the tissue that it strikes. This hole ranges from round (diameter approximately the same as the bullet) to oblong or slit-like (length approximately the same as bullet's length when the bullet is traveling at maximum 90° yaw or going sideways relative to the bullet path). Second, the tissues surrounding the bullet tract form a temporary cavity as they are stretched by being driven in a radial direction away from the bullet path.

Previously, we demonstrated that the permanent tissue disruption from the stretch of temporary cavitation was minimal in muscle penetrated by nonfragmenting solid brass 5.56-mm, 3.1-gm bullets (2). Using the same experimental design, we also studied other soft-tissue wounds in living anesthetized swine including bowel wall, lung, and liver (unpublished data). The AK-74 produces identical wounds (Figs. 4–7) to those produced by the other nonfragmenting bullets (2).

Recognizing that temporary cavitation is nothing more than a stretch of the tissues (generally no larger than 15 times bullet diameter), one would expect that elastic tissues would sustain little residual gross damage and that nonelastic tissues would exhibit greater permanent disruption. Our results demonstrate that this is exactly what happens. In addition, we accumulated evidence (supporting our previous findings [2]) that tissue elasticity is a more significant determinant than the amount of energy deposited or the size of the temporary cavity in determining the amount of damage done by a particular bullet.

Our tests indicate that the Russian AK-74 bullet exhibits the characteristics expected of a full-metal-cased military bullet. By knowing the characteristics of the AK-74 bullet (particularly its nonfragmenting behavior in living soft tissue) and the type of wounds it produces, operating surgeons should be able to assess the wounds expeditiously and approach treatment accurately.

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