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A Death from an Air Gun

Air and spring actuated guns firing spherical or elongated projectiles are widely used for target practice and pest shooting. Although their ability to inflict physical injury is well recognized, the fact that some of these guns are potentially lethal is surprising to those not familiar with their history and ballistics. The Austrian armies, for example, used air rifles against the French during the Napoleonic wars of 1799–1809 [*1*]. These were rifles of 12.8-mm (1.50-in.) caliber and had an effective range between 100 and 150 yards (91 and 137 m). An air rifle of unknown caliber was also carried by the Lewis and Clark expedition of 1804–1806 [2] and was used on occasion to kill deer-size animals as well as birds and small game.

The following report describes the investigation of a death from an air gun. The accidental killing of a 5-year-old boy by his 7-year-old sister poignantly demonstrates that certain pellet-firing air rifles are indeed lethal at close range. This case was submitted to the Ventura County, California Sheriff's Department Crime Laboratory for examination and study. The unusual circumstances of the incident prompted a thorough assessment of the potential lethality of air-spring guns. The particulars subsequent to the shooting involved an alleged time delay of the responding ambulance and alleged charges by attending physicians that the victim would have survived had he received prompt medical attention. This and other aspects of the case were well aired in the local press.

The Incident

An investigative collation of witnesses' statements and physical evidence indicated that the victim was shot in the left chest when he ran, quite suddenly and without warning, between the target and pellet rifle at the precise moment of firing. The approximate muzzle to target impact distance was 5 ft (1.5 m). The victim was bare chested and there was no intervening clothing to attenuate pellet penetration. Open heart surgery failed and the victim expired approximately 30 to 40 min after the shooting.

Autopsy Report

The victim was described in the report[3] as a well-developed, well-nourished

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Caucasian male child of 5 years of age, weighing 50 lbs (23 kg) and approximately 30 in. (760 mm) in height. The body showed no injury or deformity except for a gunshot wound in the left chest wall. Under the gunshot was a transverse surgical incision 3½-in. (89-mm) long. Internal examination showed that the left chest contained approximately 200 cm^3 of blood. The abdomen showed no abnormalities.

The entrance wound on the left chest was 2 in. (51 mm) from midline and 12 in. (305 mm) from the crown of the head. The wound was about 0.25 in. (6.35 mm) in diameter, including the rim of abrasion, and with no powder burns. There was no exit wound. A well-shaped elongated air or spring gun pellet was lodged to the left side of the tenth thoracic vertebra. The direction of the wound track was anterior to posterior, slightly left to right (approximately 10 deg) and in the horizontal plane.

Penetration was noted in the pericardial sac anteriorly, the right ventricular wall, the interventricular septum, the posterior wall of the left atrium, the pericardial sac, and the thoracic aorta. The left lung showed a contusion wound but no penetration. The cause of death was a gunshot wound of the heart and aorta and hemothorax of the left chest.

The Weapon

The weapon collected at the scene of the incident and transported to the crime laboratory for examination was a Sheridan "Blue Streak" model of 5-mm (0.20-in.) caliber. This is a single shot, pump-up pneumatic rifle wherein the forearm is used as the pump handle and the power is regulated by the number of pump strokes (Fig. 1). The barrel is rifled with six lands and grooves, right-hand twist, and is 18¾ in. (477 mm) in length.

The Sheridan air rifle uses a distinctive pellet that differs from other standard commercially available pellets both in diameter and shape (Fig. 2). The diameter of this pellet is 5 mm or 0.20 in. as opposed to the standard 4.5-mm (0.177-in.) or 5.5-mm (0.223-in.) pellets. Rather than the flat spool shape of the standard pellet, the Sheridan is round-nosed and has a 0.036-in. (0.914-mm) wide obturating band or skirt at the base. The average weight of the pellet is 15.6 grains. Sectional density is computed at 0.0592, the ballistic coefficient is 0.260, and the pellet has an ogive of approximately 1.0 calibers.

Methods

The Sheridan pneumatic rifle was subjected to extensive test firing to establish pellet velocity and energy within the manufacturer's recommended pump strokes of 1 to 10. Penetration tests were also conducted, and comparison test firings with other BB and pellet-firing guns were also included in the study.

Velocity determinations were made with an Avtron Model T-333 electronic counter

FIG. 1—*Sheridan "Blue Streak" 5-mm (0.20-in.) caliber, single shot, air rifle. The forearm is hinged at the forward end and acts as the pump handle.*

FIG. 2—*A comparison of air and spring gun pellets and BB shot.* Left to right: *4.5 mm (0.177 in.), 5 mm (0.20 in.), 5.5 mm (0.223 in.) and spherical BB shot (4.5 mm or 0.177 in.).*

chronograph and averaged for a ten-shot series. Recovered pellets were examined microscopically for identifiable markings.

Test Series

Velocity data for a Sheridan pneumatic rifle were published by W. H. B. Smith [*1*] and B. Fritz [*3*], indicating a muzzle velocity ranging from 265 to 700 feet per second (fps) (81 to 213 m/s), depending on the number of pump strokes. Velocity determinations by this laboratory are in reasonable agreement with these two authorities. It is probable that there would be differences in the velocity developed by different guns with the same number of pump strokes due to small variations during manufacture. Velocities as determined by the Ventura County Crime Laboratory are shown in Table 1.

It was found that there was a velocity loss due to leakage from the air chamber if the test rifle was allowed to sit for any length of time between pumping and firing. The test rifle demonstrated a velocity loss of 35 fps (11 m/s) within 1 h, 96 fps (29 m/s) after 2 h, and 298 fps (92 m/s) after a 24-h firing delay, all with eight pump strokes. The velocity loss after 1 h with three or four pump strokes was negligible. It is not known if this is normal or simply unique to the test rifle. All velocity measurements were made immediately after pumping to minimize air pressure loss.

Penetration tests were conducted by firing into 2½ by 5 by ¾-in. (63.5 by 127 by 19-mm) paraffin blocks and 2¼ by 4⅞ by 3¾-in. (57.2 by 123.8 by 95.3-mm) soft laundry soap blocks. The pellets penetrated the ¾-in. (19-mm) thickness of paraffin at all velocities given in Table 1. Results of the soap block penetration tests are shown in Table 2. The Sheridan pneumatic rifle achieved its maximum soap penetration at eight strokes of the pump, after which it failed to effect any deeper penetration. This appeared to be due to compression of soap pushed in front of the pellet when it reached the 610-fps (186-m/s) velocity range.

Several other BB and pellet guns were included in the test series for comparison. A spring actuated .22 caliber pellet rifle (Tell, Germany) achieved a muzzle velocity of 365 fps (110 m/s) and penetrated 2.10 in. (53.34 mm) of soap. BB shot from a Daisy Model 25 spring actuated gun registered 313 fps (96 m/s) and penetrated 0.65 in. (16.51 mm) of soap. Other BB guns tested gave lower velocities and less than 0.5 in. (13 mm) of soap penetration. A German made (Diana), .177 caliber, spring actuated pellet rifle averaged 512-fps (156-m/s) muzzle velocity and penetrated 2.81 in. (51.05 mm) of soap.

Discussion and Analysis

Modern pneumatic and spring actuated pellet rifles from .177 to .22 caliber are much more powerful weapons than the common BB gun. Experiments conducted by the United States Army Medical Department [*4*] have demonstrated that projectile or

TABLE 1—*Velocities for a Sheridan pneumatic rifle as determined by the Ventura County Crime Laboratory.*

Pump Strokes, no.	Muzzle Velocity,[a] fps	Muzzle Energy, ft·lb
2	325	3.7
3	408	5.6
4	454	7.2
5	523	9.5
6	564	11.0
7	586	11.9
8	610	12.8
9	629	13.7
10	669	15.5

1 ft = 0.3048 m
1 ft·lb = 1.3558 J
[a] Average of ten shots.

missile penetration of skin, bone, and deep soft tissue is primarily a function of impact velocity, moderated in varying degrees by such factors as hardness, shape, and weight.

Experiments on animals and human cadavers have shown that an impact velocity of 150 to 170 fps (46 to 52 m/s) is required to break human skin and approximately 200 fps (61 m/s) for preliminary penetration of bone [*4*]. In other words, a projectile or missile must have a minimum impact velocity of 350 to 370 fps (107 to 113 m/s) for initial penetration of skin and bone, and if the velocity is under 170 fps (52 m/s) it is unlikely to penetrate beyond the skin. The velocity necessary to penetrate the eye is, of course, somewhat less than this, requiring only about 130 fps (40 m/s). Any velocity in excess of those given allows increasingly deeper penetration into other tissue.

If clothing intervenes between the skin and the impacting projectile, an additional velocity proportional to the layer thickness is required over the minimum 170 fps (52 m/s); otherwise there will be no skin penetration. There is a critical velocity below which skin penetration would not be effected; when dealing with low impact velocities, a heavy shirt or jacket can absorb whatever excess velocity is present, making skin penetration impossible.

The velocity developed by two pump strokes of the test rifle (325 fps or 99 m/s) is sufficient for penetration of skin and shallow soft tissue but not for penetration of skin and bone. However, the velocity of 408 fps (124 m/s) developed by three pump strokes

TABLE 2—*Results of soap block penetration tests.*[a]

Pump Strokes, no.	Soap Penetration, in.[b]
2	1.50
3	2.25
4	2.50
5	2.75
6	2.85
7	2.87
8	2.88
9	2.88
10	2.88

1 in. = 25.4 mm
[a] All shots fired at a muzzle to target face distance of 5 ft. (1.5 m).
[b] Average penetration of three shots.

is sufficient for penetration of skin, bone, and moderate tissue, or if no bone is encountered, of skin and deep tissue.

Experimentation with the submitted Sheridan pneumatic rifle demonstrated that with each pump stroke the air in the air reservoir made each succeeding pump stroke increasingly difficult. It is highly improbable that an average 7-year-old child could manage more than three to four pump strokes. However, this is sufficient to inflict the damage described in the autopsy report at the short range of 5 ft (1.5 m).

The small size and physical development of the victim, the lack of protective clothing, very short impacting range, and the angle of pellet impact are all important causative factors. Although purely speculative, it is highly probable that an adult male struck by the same pellet under identical circumstances would have survived the wound. It is also probable that had the pellet struck a rib it would have failed to completely penetrate the heart and the victim might have been saved. The impact velocity of approximately 400 fps (122 m/s), less the 150 fps (46 m/s) required for skin penetration, left an effective velocity of approximately 250 fps (76 m/s) for penetration of the thin chest wall and the heart.

Criminalistic Data

The fatal projectile was not submitted to the laboratory for examination; however, comparative microscopic examination of expended, test-fired pellets provided the following data.

1. The bolt that chamber-seats the pellet (Fig. 3) scribes the interior base surface with a reproducible, identifiable marking that is protected from obliteration by virtue of its location.
2. The brass, rifled bore was void of tool marks due either to lapping during the manufacturing process or passage of the lead pellets and in consequence did not leave rifling marks of forensic value.
3. The soft, malleable, pure lead pellets are easily impressed by textured material such as clothing. It proved possible to obtain a thread count and texture pattern from the nose of pellets fired through bed sheeting.
4. As a corollary to Point 3, pellets fired into any hard material are easily deformed and external identifiable markings are often destroyed.

Conclusion

The most critical single factor affecting pellet gun lethality is the actual impact velocity of the pellet, which is a function of the initial (muzzle) velocity mitigated by distance and ballistic characteristics. The second most important factor, as with all gunshot fatalities, is the area and circumstances of the pellet impact. Any air, spring, or CO_2 actuated pellet gun capable of developing a muzzle velocity in excess of 350 to 400 fps (107 to 122 m/s) has a lethal potential at close range, under circumstances ideal for maximum pellet penetration. Based on the provided circumstances, submitted

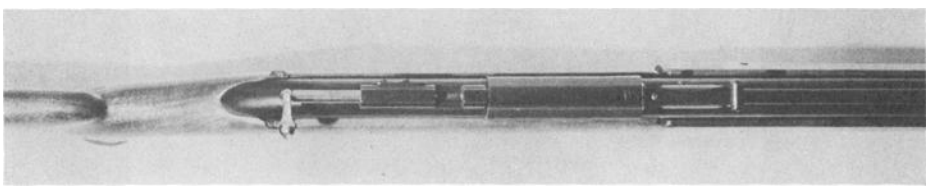

FIG. 3—*Top view of Sheridan air rifle with bolt open and chambering groove and rear of pellet chamber exposed. The bolt scribes the interior of the pellet with identifiable markings.*

weapon, and laboratory experiments, no more than three pump strokes of the pellet gun tested would be required to achieve a potentially lethal impact velocity at a distance of 5 ft (1.5 m). This number of pump strokes is within the physical capability of the average 7-year-old child.

In cases involving pellet-firing rifles or pistols, it is necessary to establish the actual muzzle velocity of the weapon in question through a series of chronographed test firings. Laboratory experiments for the case described here indicate that there can be wide variations in the muzzle velocity of different pellet firing guns, even of the same model. The case presented here demonstrates that pellet guns should be subject to the same safety precautions as guns using gunpowder and not placed in the hands of children for use under unsupervised conditions. It is hoped that the facts presented will not be used as grounds for restrictive legislation concerning air or spring guns, but rather as a warning that they must be respected as potentially lethal at close range under certain conditions.

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