TECHNICAL NOTE

Boyd G. Stephens,[1] *M.D. and Terence B. Allen,*[1] *M.D.*

Back Spatter of Blood from Gunshot Wounds—Observations and Experimental Simulation

REFERENCE: Stephens, B. G. and Allen, T. B., "**Back Spatter of Blood from Gunshot Wounds—Observations and Experimental Simulation,**" *Journal of Forensic Sciences*, JFSCA, Vol. 28, No. 2, April 1983, pp. 437-439.

ABSTRACT: It is well known that gunshot wounding can produce fine droplets of blood spattered in a forward direction. Under certain circumstances blood droplets can also be propelled backwards in a direction against the line of fire. Although the phenomenon of back spatter of blood is most commonly seen in contact gunshot wounds of the head, its occurrence is not well recognized. In this article we summarize investigative and experimental observations concerning back spatter. We suggest that back spatter is a type of "blow-back" effect produced by discharge of a large volume of gas in a confined space.

KEYWORDS: criminalistics, wound ballistics, blood

The distribution of blood projected from a gunshot wound can be valuable information in understanding and reconstructing a gunshot wound or death scene [1]. Most forensic science experts have observed blood and material that is spattered in a backwards direction from gunshot wounds, but the phenomenon is not well described in the literature and is not generally referred to in standard texts. As a result there have been considerable differences in expert interpretation of crime scenes and court testimony. Some experts have even testified that back spatter of blood from gunshot wounds does not exist [2].

The purpose of this article is to report that back spatter does occur in certain types of gunshot wounds and can be reproduced in mock experiments. Obviously when an object penetrates a liquid, material may be splashed in the direction from which the object came, as in the classic high-speed photographs of a liquid drop hitting a smooth liquid surface. The mechanism of firearm induced back spatter however is more complex than simple splashing or displacement and we have observed that certain conditions are required for back spatter to occur. The occurrence of back spatter of blood is easily demonstrated experimentally and is not a paradoxical or unexpected effect.

Received for publication 31 Aug. 1982; accepted for publication 15 Sept. 1982.

[1]Chief medical examiner-coroner and forensic pathology fellow, respectively, San Francisco Medical Examiner's-Coroner's Office, San Francisco, CA.

Materials and Methods

Simulated gunshot wounds were made with a .38 caliber revolver. The impact site was a blood-soaked sponge that was encased or wrapped in a variety of materials including hard plastic, sheet rubber, Naugahyde*, and tape. The back spatter of blood was observed by placing a white target at various distances behind or slightly to one side of the revolver, perpendicular, or parallel to the line of fire. Back spatter was observed from tight contact, loose contact, angled contact, and near firings.

Observations

In our experience backwards spatter of blood occurs most commonly in association with contact gunshot wounds of the head. A gunshot in which the barrel is placed against the temple frequently results in finely spattered deposits of blood on the dorso-medial hand and sleeve, or forearm of the extremity that held the gun. Portions of the hand covered by the gun may be unmarked and we have observed in some cases a clear "shadow" or void on the trigger finger produced by protection of the trigger guard. Starburst or stellate entrance wounds in which a "blow back effect" creates a pocket-like space within the scalp [3] are commonly associated with back spatter. Back spatter is not typically associated with distant gunshot wounds, or wounds in which there is a potential space immediately underlying the entrance site thereby supporting rapidly expanding gas or gas pressure as the principal cause. We have occasionally observed back spatter with .22 caliber weapons, but we believe the effect is more common with large caliber hand guns. Back spatter rarely occurs with gunshots wounds of the abdomen or chest.

Experimentally, back spatter is produced only by contact or near contact gunshot discharge. A tight air seal between muzzle and impact site is not required but at distances of 2 to 3 mm back spatter is markedly reduced, and at distances over 1 cm back spatter is negligible. Spatter may be asymetrical or more varied in distribution if muzzle contact is loose on one side. Blood is spattered from a blood-soaked sponge backwards and on both sides for 30 to 50 cm in a very fine spray, including bits of sponge and, in one instance, a fragment of lead (when a hard plastic support was encasing the sponge).

To simulate realistically back spatter it is necessary to encase the blood-soaked sponge in a relatively elastic membrane, such as a rubber sheet which bursts open under the impact of a contact discharge. If only a bare sponge is the impact site, the back spatter is a flooding "splash" that drenches the target and does not produce realistic finely spattered droplets. The same sponge loosely rolled in a rubber sheet that bursts open under fire produces on the target a back spatter of fine droplets. A sponge encased in hard plastic will produce no back spatter if the plastic encasement remains intact.

Discussion

Forward spatter of blood from gunshot wounds results by a direct transfer of kinetic energy from the discharge of a firearm to blood and tissue with resulting motion in the direction of fire. Back spatter, in which particles of blood and tissue are subject to forces that propel them against the line of fire, is different in cause and results than forward spatter. Based on observation and experimentation we suggest that back spatter is caused by the rapid expansion of gas within a buttressed space. The actual spatter occurs when the skin is stretched by high pressure with resulting rupture in a characteristic cruciate fashion or enlargement of the wound so that blood is released around the side of muzzle. The accelerating force is the backwards stream of escaping gas trapped between the elastic skin and rigid skull.

Material other than blood can be propelled in a backwards direction by gunshot. Back-

ward fragmentation of glass is well known [4], and we are begining to realize that under some circumstances an entrance gunshot wound of the skull may show reverse coning.[2]

Backwards spatter of blood from gunshot wounds is a complex phenomenon which we do not pretend to understand completely. The simple observations and experiments that we report can easily be repeated and should convince anyone that back spatter does exist. A variety of poorly defined factors may affect back spatter including caliber of the weapon, type of ammunition, barrel length, and anatomic features of the wound site. The presence of clothes or hair may impede droplet flight and reduce back spatter. We have not been able to produce back spatter experimentally with distance discharge, and we have not observed back spatter from distant wounding during investigation of actual cases. By whatever mechanism, the back spatter of blood from gunshot wounds does occur and should not be considered a paradoxical or anomalous effect.

References

[1] MacDonell, H. L., "Interpretation of Bloodstains—Physical Considerations," *Legal Medicine Annual*, Appleton-Century-Crofts, New York, 1971, pp. 89-136.
[2] *People v. Marino*, Calif. Sup. Ct., #A344097, Los Angeles, California, 1980.
[3] Spitz, W. V. and Fisher, R. S., *Medicolegal Investigation of Death*, Charles C Thomas, Springfield, IL, 1973, p. 190.
[4] Thornton, J. I., Ed., *Crime Investigation*, John Wiley and Sons, New York, 1974, p. 262.

Address requests for reprints or additional information to
Boyd G. Stephens, M.D.
Chief Medical Examiner-Coroner
San Francisco Medical Examiner's-Coroner's Office
850 Bryant St.
San Francisco, CA 94103

[2]J. I. Coe, personal communication, Minneapolis, 1981.