

Literature Review & Comment

THE "SHOCK WAVE" MYTH

The following letter was published in the *Journal of Trauma* (29[10]:1455, 1989). No reply was made by the authors and no editorial comment was made.

To the Editor of the *Journal of Trauma*:

In ascribing "local, regional and distant injuries" to the sonic pressure wave, Suneson et al. ("Pressure wave injuries to rat dorsal root ganglion cells in culture caused by high-energy missiles," *J Trauma* 29:10-18, 1989) have overlooked the effect of transmitted tissue movement from temporary cavitation. Since two distinct mechanisms are acting in the Suneson et al. experiment, one cannot arbitrarily assign any effects observed to only one of them.

Movement of tissue by temporary cavity formation is a well-known tissue disruption mechanism, but the sonic wave does not move tissue perceptibly. Harvey (1, and Suneson et al. ref 4) clearly identified temporary cavity formation, not the sonic pressure wave, as the tissue disruption mechanism in all of his experiments. As with any blunt trauma, tissue movement initiated by temporary cavitation can be transmitted to other parts of the body than those impacted.

Suneson et al., also neglected to define "high-energy." The energy "transferred" by the 6mm sphere in their experiment was no greater than that available in many common handgun bullets. Uncomplicated extremity wounds from handgun bullets are handled on an outpatient basis

in many of our urban hospitals with excellent results (and no signs of the "distant" injuries).

Recently, eleven adult-human-sized swine (90 kg) were shot in the proximal part of the hind leg with a projectile producing the damage profile of the Russian AK-74 Assault rifle bullet (2). This same projectile was used in another study in which five 90 kg swine were shot through the abdomen (3). These animals were observed from three weeks (leg shots) to two months (abdomen shots). No indication of any sort of "distant" damage was seen in the pigs' behavior and no "distant" injuries were found at autopsy.

A review of 1400 rifle wounds from Vietnam (Wound Data and Munitions Effectiveness Team) should lay to rest the myth of "distant" injuries. In that study there were no cases of bones being broken, or major vessels torn, that were not hit by the penetrating bullet. In only two cases, an organ that was not hit (but was within a few cm of the projectile path), suffered some disruption (personal communication, Bellamy, R.F., 1989).

REFERENCES

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COMMENT

Five months after the above letter was published, *J Trauma* printed two more papers by Suneson et al., which repeat the same basic errors and misconceptions as the one about which the letter was written (1,2).

To separate the two mechanisms of sonic pressure wave and temporary cavitation, Harvey et al.(3) shot into a steel plate which stopped the projectile (and its cavitation) but exposed the target to just the sonic wave. This classic work by Harvey et al. clearly identified temporary cavity formation, not the sonic pressure wave, as the tissue disruption mechanism in all of their experiments. Some who have read Harvey et al. come away with the impression that they ascribed pathology to the sonic pressure wave in air-containing organs. Careful reading of these studies makes it clear that *Harvey et al. were unable to demonstrate effects caused by sonic pressure waves in any tissues -- solid or air-containing.*

Tissue movement is tissue movement; whether initiated by temporary cavitation or by any other form of blunt trauma. It is transmitted to other parts of the body than those impacted, and when the tissues moved are sufficiently susceptible and the movement of sufficient magnitude, damage can be done. Why ignore this obvious cause, and attribute the observed changes to sonic waves, which do not move tissue, and have been shown to cause no tissue

damage (3)? Could it be that the competition for research funds is the motive for trying to make these mechanisms of injury appear as complex as possible?

Anyone who has viewed a high-speed cine film of a 20 kg pig shot in the hind leg by projectiles producing temporary cavities the size of the sphere used by Suneson et al. recognizes that the entire animal was set in motion. Although Suneson et al. include no description of the local tissue disruption (thus depriving the reader of any chance to compare these wounds with those in his own experience), others report broken femurs with similar shots (4,5). Rather than the "control" used by Suneson et al. (shooting their "smoothbore rifle" but missing the leg), perhaps striking the leg with a baseball bat hard enough to break the femur would be more appropriate. I suspect it would also cause the changes that Suneson et al. found with their electron microscope and attributed to sonic pressure waves caused by their sphere.

Wound ballistics research needs to be guided by problems from the field of battle. Common sense must guide the use of technology rather than being overshadowed by it.

Is it not the duty of a journal editor to assure continuity of thought in the material published? To avoid the perpetuation of error? It is truly surprising (and sad) that the trauma surgeons and other *J Trauma* readers tolerate this continuing comedy of errors related to wound ballistics papers.

NOTE

It has come to our attention that the University of Gothenburg, Sweden, has recently turned down the PhD thesis (by the first author) based largely on these "high energy missile" papers. By printing

these faulty papers the **J Trauma** has done a disservice not only to their readers, but to the papers' authors as well..

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