A METHOD FOR IMPROVING THE GRIESS AND SODIUM RHODIZONATE TESTS FOR GSR PATTERNS ON BLOODY GARMENTS

Lucien C. Haag
Forensic Science Services
Phoenix, AZ

Introduction

Every time I look at a bullet hole in a bloody garment I think of Lady MacBeth ("Out! Out! damn spot · ·"). Since people consistently bleed when they are shot, the obscuration of gunshot residues and/or patterns on garments by post-injury exsanguination and saturation of these garments is an obvious problem. It is also reasonable to expect that shooting victims will continue to provide us with bloody clothes which we will be expected to examine for evidence of close proximity discharge products. Given this perpetual and somewhat intolerable situation, I elected to do something about it. Reasoning that lead deposits and adhering/embedded powder particles are reasonably insoluble in neutral to mildly alkaline aqueous solutions, some initial efforts were made using normal saline solution as a preferential extractant for dried blood. A procedure was developed that was reasonably successful. This was reported before several professional groups in the Spring of 1990 at which time several alternative reagents were suggested by some of the attendees. These suggestions were acted upon and resulted in some further improvements in the technique.

General Method of Evaluation

To evaluate the efficacy of various extractants, panels of cotton, polyester and Naugahyde with visible GSR patterns (powder particles, soot and vaporous lead deposits) stained with human blood were allowed to air dry and 'cure' for several weeks at ambient temperatures of 100 to 110°F. The cloth panels were cut into pie-shaped sections radiating out from the center of these symmetrical GSR patterns. Sufficient sections were cut to accomodate the various extractants under study and to leave one section untreated. Plastic trays were used which were of sufficient size to allow the sections of cloth to lay flat under a minimum volume of extracting solution. Twelve to 24 hour room temperature soaking with occasional gentle rocking of each tray was carried out. At the end of this time each extracting solution was tested for dissolved nitrites and lead. The cloth panels were rinsed once in distilled water then allowed to drain and air dry on an inclined, non-porous surface. Temporary reassembly of the pie sections allowed a ready means of assessing the effectiveness of the blood removal. Each pie section was then cut in half so that the possible reduction or partial removal of lead

deposits by the Griess test procedure could be evaluated. This was done by processing one of the two halves with the Griess test (using treated photographic paper and steaming with 15% acetic acid from a cloth overlay) followed by a sodium rhodizonate test using a filter paper lifting technique with a pH 2.8 tartrate buffer. The other half of the pie section was simply processed for lead residues (omitting the Griess test) by means of the tartrate buffer-filter paper lifting technique. If the garment used was not a dark fabric, the rhodizonate reagent was also applied directly to the fabric as a last action. All results were photographed and the lifts retained.

Extractants

The following extractants were evaluated:

- normal saline solution (0.9%w/v NaCl in water)
- 5%v/v ammonium hydroxide solution (5ml of conc. NH_4OH diluted to 100ml)
- "The Eliminator"- a proprietory blood removal solution made by the Marrick Company in Indianapolis Indiana (317) 545-4084 Solutions of a 1:7 and 1:15 dilution of the liquid concentrate were used.
- Haemo-Sol manufactured by Haemo-Sol, Inc. in Baltimore,MD and available through Baxter Scientific Products (Cat. #C6325). A 0.2%w/v aqueous solution of this product was used.

RESULTS:

Numerous bloodstained GSR patterns on old and new cotton T-shirt material, heavy canvas, corduroy jeans, polyester slacks and naugahyde seat cover material have been processed with these reagents over the past 8 months. All of them have been photographed, the tartrate-rhodizonate lifts (when taken) and the Griess test papers have been retained in a large binder by the author in the event any member would like to view any of them firsthand at some future time. The photographs in this article show typical results.

Evaluated simply on their efficacy as blood removal agents, these solutions rank as follows: Normal Saline $<$ NH_4OH $<$ Haemo-Sol $\approx$ Eliminator. None of these extractants removed any significant quantities of nitrites as evidenced by negative spot tests for nitrites performed on the evaporated residues from 0.5ml aliquots of these solutions. Additionally, the modified Griess test results carried out on the reassembled panels gave similar results for the treated and untreated sections. In fact, the embedded and adhering powder particles which had been obscurred by the heavy blood stains were not significantly disturbed by the slow extraction process when carried out as described (see Photos 4 and 5). The tests of these solutions for nitrates on the other hand were always positive which would strongly suggest that the nitrite-bearing constituents

in GSR patterns are bound up in discrete insoluble particles but this is not the case for nitrate residues.

The lead residues in these GSR patterns were all in the form of a vapor or fog-like deposit as a consequence of the type of ammunition employed. This was intentional and aided in detecting subsequent lead loss or redistribution by the various extractants evaluated.

Direct development of the lead residues on white cotton revealed some loss of lead with the normal 1:7 dilution of the Eliminator. A 1:15 dilution appeared to obviate this and still effectively remove the obscuring blood.

When the three features of blood removal, lead residue retention and nitrite/powder particle retention were considered together Haemo-Sol had a slight edge over the Eliminator. Both were superior to normal saline and 5% ammonium hydroxide solution.

SUMMARY:

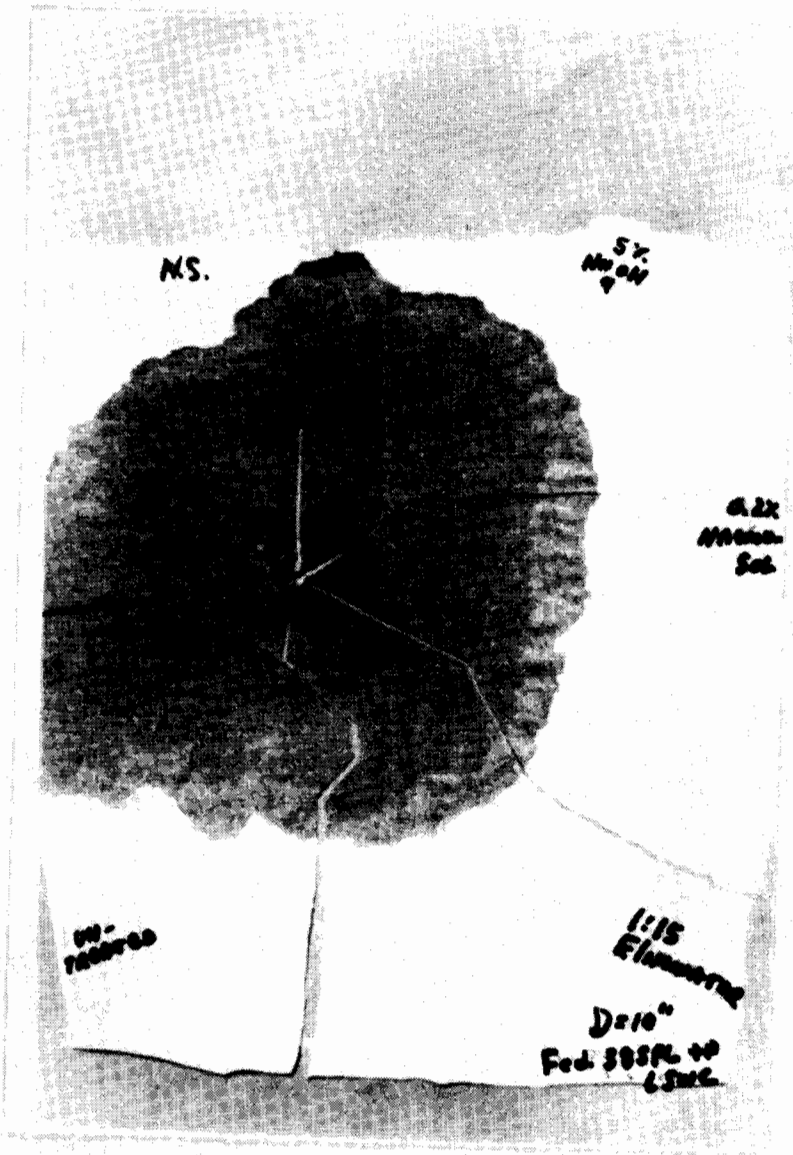
Post-injury blood stains can obscure gunshot residues associated with close proximity discharges onto or through clothing. Dried blood may also act as a barrier to transfer or lifting techniques used to raise nitrite and/or lead residues. The transfer sheets or papers themselves frequently become contaminated with partially solubilized blood which also obscures any positive response that may have occurred on the test paper.

Given the recurring nature of these problems, a procedure for the preferential removal or reduction of such interfering blood stains was sought. A 0.2%w/v aqueous solution of Haemo-Sol was found to give very satisfactory results when used as described in this paper. This procedure offers a means to improve upon existing and well-established GSR testing methods particularly where the initial attempts have been thwarted or complicated by the presence of heavy blood stains.

In the event the examiner has any reservations in some future case, a pre-application evaluation could be carried out by simply cutting a small panel from the garment in an unstained and non-critical area. This panel would be shot in such a way as to leave a GSR pattern. The test panel would be stained with blood, dried, "cured" and cut up into several pie-sections for static extraction and subsequent testing.

L. Haag

PHOTO 2



An old cotton T-shirt containing a GSR pattern obscured by blood.

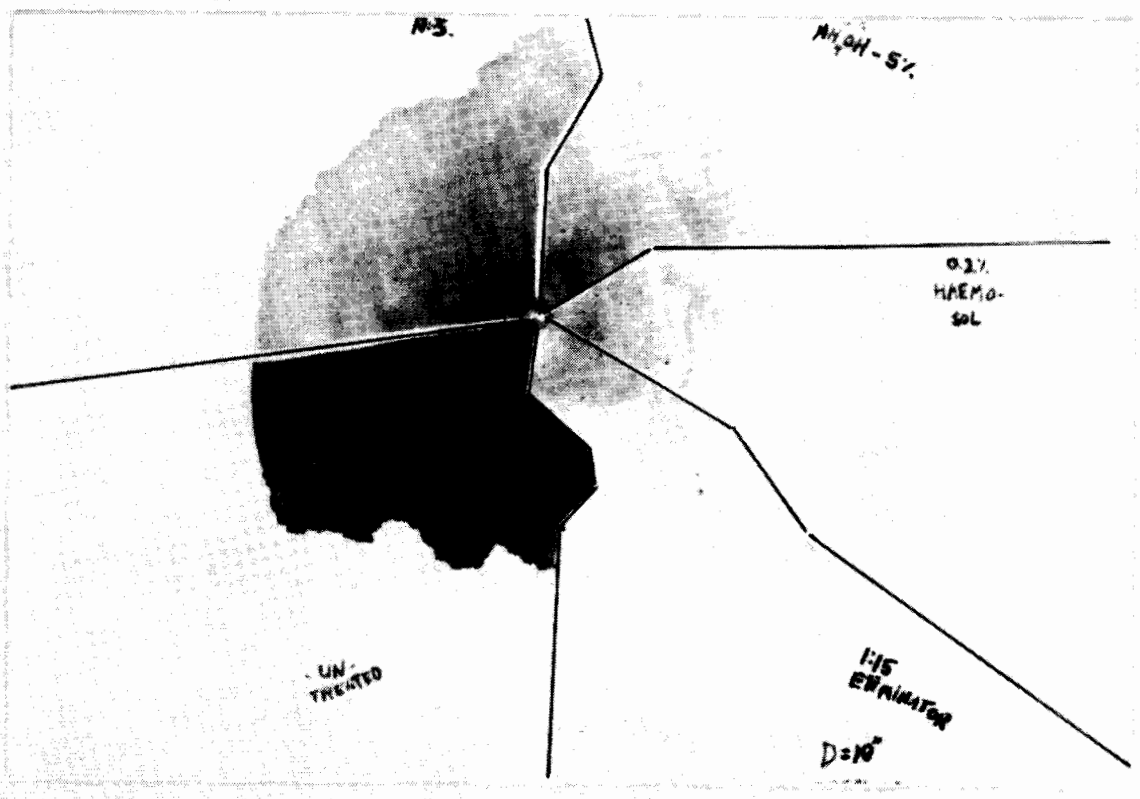
PHOTO 1

A representative gunshot residue pattern prior to saturation with human blood.

PHOTO 3

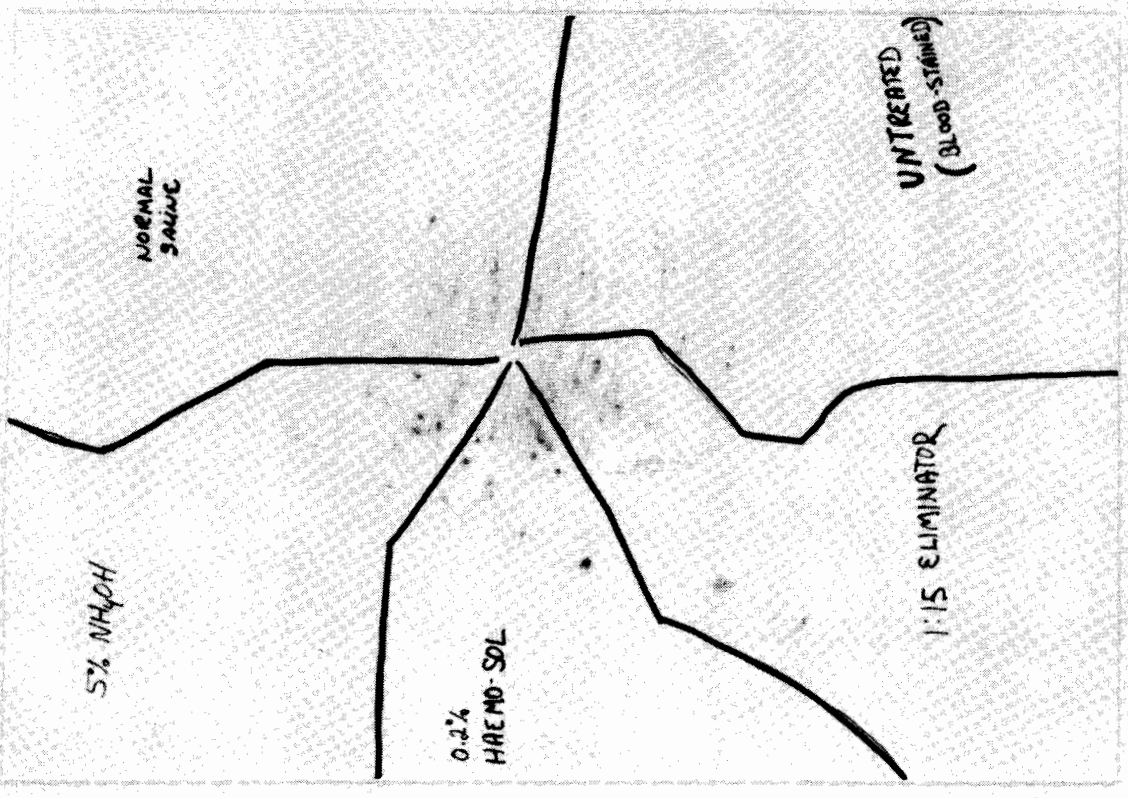
The four sections from **Photo 2** after 24 hours in the extraction solutions. The **untreated** section is in front of the extraction trays.

PHOTO 4



Reassembled section of cloth shown in **Photo 2** after 24 hour extraction process. Note that discrete powder particles and the sooty GSR deposits can be seen in the sections extracted with Haemo-Sol and the Eliminator.

PHOTO 5



Griess test results (note right-left reversal) of the reassembled sections shown in **Photo 4**. This was carried out by the sensitized photographic paper-acetic acid-steam iron method.