



Determination of the blood volume of bloodstains on clothes: a case report

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Death due to hypovolemic shock may occur when the blood volume lost reaches about one-third of the whole volume contained in an adult human body [1]. Bloodstained clothes and other objects found in a car were sent to our laboratory. The aim was to investigate the identity and the amount of blood present on the clothes and objects in order to determine if the amount of blood present on them was enough to cause death.

DNA extractions have been performed from each sample [2]. AmpliFSTR Profiler Plus and COfiler kits (Applied Biosystems) have been used for PCR amplifications to determine the entity of bloodstains.

Dry weight of blood measurement has been performed using the Strassmann and Ziemke method [3], by which identical surfaces have been cut, both completely stained with blood or totally clean. Weight means for both stained and clean cuttings have been calculated for each piece of clothing. Dry weight of blood contained in spots on clothes per surface unit has been obtained by calculating differences between both values. Total

Table 1

Sample	Weight/surface ratio, g/cm ²	Spots surface, cm ²	Total dry weight, g	Blood volume, l
Blanket 1	0.043440	2344.600	101.84942	0.48269
Blanket 2	0.045150	4518.330	204.00	0.97142
Shirt 1	0.002100	1619.066	3.474	0.01646
Shirt 2	0.000044	242.330	0.0106626	Negligible
T-shirt**	0.008359	8254.220	68.997	0.32700

Total volume calculated: 1.79757 l.

**Surface of each cut on this garment is 67.24 cm², using a 8.2 cm × 8.2 cm metallic plate. For the remaining clothes, a 19.76 cm² surface glass microscope slide was used.

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stained surface has been calculated using tracing paper. Stains have been traced and the resulting piece of paper weighed. Applying weight/surface ratio, surface of each stain has been obtained. The Harmstem ratio (1 l of blood yields 211 g of dry weight) [4] has been applied and volumes obtained for each piece of clothing summed and the results are shown in Table 1.

DNA profiles obtained from the bloodstains were all identical, supporting the hypothesis that the bloodstains were from the same person. Other DNA-based identification procedures have been performed by other experts (data not shown).

No corpse was found, but suspects (one woman and two men) were convicted.

References

- [1] K.J. Iselbacher, et al. (Eds.), Harrison. Principles of Internal Medicine, 13th ed., McGraw-Hill, 1992.
- [2] B. Budowle, et al. (Eds.), DNA Typing Protocols: Molecular Biology and Forensic Analysis. BioTechniques Books, Eaton Publishing, 2000, p. 17.
- [3] L. López (Ed.), Técnica Médico-Legal, Saber, Valencia, Spain, 1953.
- [4] C. Lentner (Ed.), Geigy Scientific Tables, vol. 3, Ciba-Geigy Limited, Basel, Switzerland, 1984.