Authors Response

Sir,

We are grateful for the opportunity to reply to the Commentary on our article entitled, "A BPA Approach to the Shroud of Turin" (J Forensic Sci https://doi.org/10.1111/1556-4029.13867. Epub 2018 July 10), by Hermosilla et al.

Their considerations seem to have been originated by a superficial reading of our article, as suggested by their comments on the use of blood with CPDA: we clearly stated that we used blood "additioned with citrate phosphate dextrose (CPD) as an anticoagulant and saline-adenine-glucose-mannitol (SAGM) […] brought to human body temperature just before use" as well as synthetic blood because "preliminary tests confirmed that the behavior of whole human blood and synthetic blood were identical, and that the results of the experiments were superimposable."

The procedure and the blood used are consistent with the guidelines and regulations for human blood transfusions. In the article, we also quoted James et al. 1 who confirm the equivalence of using fresh blood and blood with anticoagulants: "… MacDonell compared the physical properties of freshly drawn blood and samples with added anticoagulants and preservatives such as EDTA, citrate or oxalate and found no measurable difference in the way they acted."

However, we would like to point that we also used whole human blood without anticoagulant as stated in our second poster presented at the AAFS meeting in Orlando in 2015 2.

Regarding the test performed on a mannequin as well as on a living healthy individual, it is important to clarify that this approach is the ordinary common practice in BPA analysis. In this particular case, the mannequin was employed to avoid that, due to the amount of blood used, the volunteer had to take a shower after each experiment. This was impracticable, as it would add more time for each experiment, not to mention of course that we do not have any such facilities at the university laboratory.

Hermosilla et al. admit that they "do not have scientific data" on the possible presence of hair on the skin of the Man of the Shroud (henceforth MoS); despite that, they use this point to try to discredit our scientific test assuming that any hair if present would influence "the passage of any fluid, modifying its trajectory." While it is certainly true that hair (or other conditions of the skin such as a clean, powdered, or wet surface) can modify the general shape of bloodstains, it is also true that they cannot change their general trajectory that is directed by gravity.

It has been truthfully demonstrated that "in general it is evident that blood, like other liquids, behaves in accordance with established laws of physics" and consequently "bloodstain patterns on human skin are essentially no different than they are on floors, walls or other surfaces" 3.

At the same time, the idea that temperature and humidity can influence the results of our experiments is specious and scientifically unfounded. These factors can indeed influence the speed of the dripping and bleeding, but again not the direction that follows the law of gravity. Regarding the possible presence of "dirt, sweat, clots of previous bleeding" on the MoS according to the events related to Christ's Passion, it is important to underline that there is no evidence of any of these on the Shroud of Turin. If indeed the MoS was actually a scourged

individual, his body should have been completely covered by blood that would have left an imprint on the linen, but there is no evidence of this on the fabric.

Furthermore, Hermosilla et al. state that "the behavior of the blood of the man of the Shroud was different from that [of] a blood of a living and healthy man." Considering—as we said—that the direction of the stains is due to gravity, it is difficult to understand from a physical and medical point of view how the blood of a cadaver can behave against one of the fundamental forces of physics. Naturally, blood from the wound on the chest would also behave according to the law of gravity, even if mixed with possible but unproven "blood clots, pleural fluid, pericardial fluid." For these reasons, our experiment on the direction of the bleeding from the chest wound according to different positions of the body has to be considered accurate and scientifically valid.

Hermosilla et al. also speculate on the pathological condition of the Man of the Shroud and his death, which they attribute with certainty to asphyxia. We would like to point out that this topic has been debated very long 4-13, and as physicians, they should know that the death of a crucified man should not been ascribed *tout court* to asphyxia. At present, there is insufficient evidence to safely state exactly how people died from crucifixion in Roman times. It is quite likely that different individuals died from different physiological causes. Particularly, even *if* the Turin Shroud should be considered the original funerary cloth of Christ, and *if* the Gospels could be considered as a reliable source, the last scream raised by Jesus 14-16 should be interpreted as the main evidence against a death for asphyxiation.

On the topic of the origin of the "belt of blood," Hermosilla et al. seem to not understand the result of our experiment. We clearly demonstrated that, according to the direction of the blood flowing, there is no evidence of a realistic postmortem bleeding. In addition, even if this occurred, the cadaveric blood flowing from the chest would reach the scapular region leaving a big stain on the linen rather than few thin lines across the lumbar region. Furthermore, they state that "the cadavers have postmortem haemorrhages, especially when they are moved, and the body of the man of the shroud has certainly been moved and manipulated, then bleeding profusely from his wounds and his natural orifices." If we consider this statement as valid, the Hermosilla et al. should explain why the MoS did not bleed "profusely" from "his natural orifices": nose, mouth, ears, and anus.

It is also quite contradictory that Hermosilla et al. think that "blood stains of the Turin Shroud" can be analyzed "with a more scientific method" than the forensic BPA approach we presented at the AAFS scientific meetings 17, and at the same time, they quote a publication (their reference 4), from an obscure magazine—not journal—which is not even listed in the database Web of Science and clearly has a bias in its approach.

All the facts presented above suggest that the commentary written by Hermosilla et al. presents not only several limitations, but also a lack of understating of some basic principles of bloodstain pattern analysis. In addition, their conclusions are not supported by any experimental data.

Their letter gives us the opportunity to reply to their observations and also to underline how our article, entitled "A BPA Approach to the Shroud of Turin," has been written after an accurate evaluation of the experimental data obtained during meticulous and reliable tests and an overall methodology that is widely accepted by the forensic science community.

Hemrosilla et al. state that “doing science means proving a hypothesis and having that proof replicated by one's peers”; we believe that, as scientists, we planned, performed, and presented our paper respecting this scientific principle and we are open to compare our results with future experiments if they will be carried out with a similar scientific BPA approach.

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