Original article

UDC: 340.6
doi: 10.5633/amm.2025.0309

THE SYNERGY OF FORENSIC MEDICINE AND BLOODSTAIN PATTERN ANALYSIS IN DETERMINING THE MANNER OF DEATH

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A forensic pathologist and a bloodstain pattern analyst are involved in determining the manner and the mechanism of death, but based on different scientific approaches. Our work presents the benefits of a holistic approach to forensic expertise. We have analyzed and described three cases. In all cases, the initial police investigation had concluded the wrong manner of violent death (accident, suicide, homicide), but the subsequent synergy of forensic autopsy and bloodstain pattern analysis (BPA) determined the true nature of death. BPA in Serbia is a relatively new forensic discipline. Police authorities (Crime scene evidence technicians) in Serbia are familiar with BPA, but according to our legislation, they are not allowed to provide expertise in the courtroom. The benefits of synergistic expertise in forensic medicine and BPA are more than evident in our cases. Therefore, the education of specialists in forensic medicine in BPA will be useful for solving suspicious and indistinct cases.

Acta Medica Medianae 2025;64(3): 70–76.

Key words: *forensic medicine, autopsy, bloodstain, bloodstain pattern analysis*

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Introduction

A forensic pathologist and a bloodstain pattern analyst are differently educated experts. They are both involved in determining the manner and the mechanism of death, but based on different scientific approaches.

The forensic pathologist performs autopsies to determine the cause and manner of death (homicide, suicide, accidental, natural, undetermined). Also, the forensic autopsy reveals different pathological processes, injuries, and diseases that directly or indirectly initiate a series of events that lead to a person's death (the mechanism of death). The forensic pathologist examines a corpse and documents all injuries, along with the possible cause of injuries. Based on those findings, along with police crime scene reports, the forensic pathologist can determine the manner of death and the mechanism of injuries. Sometimes, those findings are insufficient for determining the manner of death and the mechanism of injuries, so another field of forensic expertise must be included (1, 2).

The bloodstain pattern analysis (BPA) is based on scientific examination of the size, shape, distribution, and location of the bloodstains to recreate the actions that caused the bloodshed and to form opinions about what did or did not happen. BPA uses principles of biology, medicine, physics, chemistry, and mathematics, so this is a multidisciplinary branch of forensic science. BPA analysts can determine types of bloodstains by gathering information from spatter patterns, transfers, voids, and others, to assist investigators in recreating the sequence of events that occurred during and after bloodshed. This important information assists the investigators in reconstructing the crime, including or excluding potential perpetrators from the investigation, and scientifically testing statements from witnesses. Based on facts and information gathered from BPA expertise, it is possible to determine the manner of death (3–7).

Currently, it is not often that a forensic expert is simultaneously educated in forensic medicine and BPA. In Serbia, there are only two forensic experts with those qualifications. Our work presents the benefits of a holistic approach to forensic expertise of violent death (4, 8).

Aim

The aim was to evaluate the benefits of the holistic approach in determining the manner of

death with the synergy of forensic medicine and bloodstain pattern analysis.

Material and Methods

Material was obtained from expert reports of the Institute of Forensic Medicine in Niš, Serbia. We have simultaneously analyzed reports of three cases, where the autopsy and the BPA expertise were performed, but individually they couldn't explain all important circumstances of the death.

Results

We have analyzed and described three cases. In all cases, the initial police investigation had concluded the wrong manner of violent death (accident, suicide, homicide), but the subsequent synergy of forensic autopsy and BPA determined the true nature of death.

Case 1: The deceased, a 73-year-old man, was found in an auxiliary house on his farm (Figure 1). From the house to the barn, many bloodstains were found on the ground, forming a drip trail pattern. Crime scene investigators found some bloodstains in front of the barn on the white bag, but also in the barn, bloodstains were found in one of the buckets with water. Police assumed that the man was injured in the barn by one of the cows, where the bloodstains began, and that he reached the place where the corpse was found. So, investigating authorities had believed at first it was an accidental death. The autopsy revealed that the death was due to a head injury, but it was unlikely that it was an accidental death.

Figure 1. A. Sitting position of the victim with bloodstains; B. Drip bloodstains forming a drip trail pattern from the victim to the barn; C. Bloodstains in the barn; D. Spatter bloodstains on the white plastic bag in front of the barn with a pool of blood (red circle) and established area of convergence of spatter pattern (red-yellow stars)

On-site BPA analysis revealed that at least three spatter patterns of bloodstains were found on the white plastic bags in front of the barn. Further analysis revealed that the point of origin of those spatter patterns was consistent with the victim's head position at the time of injury (point of origin marked by red-yellow stars). In front of the barn, a larger pool of blood was found on the ground, indicating that the victim had been motionless on the ground for a long time after suffering head injuries. Comparative analysis of blood traces in the barn with traces of diluted bloodstains on the shirt of the victim indicates that the victim was in the barn when there was already liquid blood on him, and then the victim came in contact with water. Furthermore, traces of blood flow on the head and the front of the body indicate that the injured person was in a standing position for some time after suffering a head injury. The injuries to the head were otherwise of such a nature that he could move independently for a certain period. Based on the results of BPA

expertise, the established sequence of events was: 1) victim getting injured in front of the barn; 2) entering the barn and contacting the water; 3) then probably moving independently to the auxiliary house, where the body of the deceased was found. It was then absolutely confirmed that it was a homicide.

Although the autopsy unequivocally revealed violent death, the manner of death was inconclusive. Subsequent BPA at the crime scene revealed the position of the deceased at the time of sustaining injuries, which was inconsistent with the previous assumption of accidental death. The combination of facts obtained from both reports was terminated by the arrest of two offenders.

Case 2: A man reported that he and his wife had been attacked by unknown assailants. The man stated to police that he had been attacked in front of the house, that he had sustained a head injury and lost consciousness, but immediately after his awareness, he called a neighbor to contact the police. A clinical forensic examination revealed that he was indeed injured in the occipital region, so his story was not in doubt.

The deceased 48-year-old woman was found in the bedroom, and many bloodstains were found on the wall, bed, and around the corpse (Figure 2). The on-site BPA analysis revealed that at least four spatter patterns had been located on the wall above the headboard of the bed, and placed one over the other. This practically means that each spatter pattern corresponded to at least one blow to the victim`shead. Interesting was the area with no bloodstains, and that area was the victim's pelvic region. This void area of bloodstains corresponded to some object, which was moved after inflicting injuries on the victim, and that object was the assailant.

Figure 2. A. Position of the victim with the general aspect of the crime scene; B. Bloodstains around the victim with a void area of spatter bloodstains in the pelvic area (between green lines); C. Spatter pattern on the wall above the headboard of the bed with established four areas of convergence of the spatter pattern (red-yellow stars); D. Spatter stains on the back of the T-shirt

A corpse examination of the victim revealed that there were head injuries inflicted with at least 12 blows. Most of the wounds were large linear lacerations with multifragmenting skull fractures. Those injuries were inflicted by an elongated cylindrical object similar to a pole or stick. The number and manner of inflicting injuries indicated a strong emotional discharge of the assailant, which could also mean a close emotional connection between the victim and the assailant, and at that time, the suspicion that the husband might be the perpetrator was raised. The entire house was inspected, and a bloodstained man's T-shirt was found in the laundry basket, with bloodstains on the front and back of the T-shirt. The dilemma about the identity of the person who was wearing this shirt was easily solved by later DNA analysis, and it was the husband of the victim.

Based on the corpse examination and the bloodstain pattern analysis, we concluded:

1. The victim sustained head injuries in approximately the same position of her head in the space as her corpse was found, by repeated blunt force strikes to her head.

2. The weapon used in this homicide was an elongated cylindrical object similar to a pole or stick. Later, a bloodstained metal bar was found in a cesspit.

3. The assailant was positioned above the victim, face to face, probably sitting across her pelvic region or by some other part of his body covering her pelvic region. From this position, the assailant, who wore a gray T-shirt during a critical event, swung a blood-stained weapon over his head and his right shoulder, and he probably held the weapon in his right hand when blood spatters were projected on the back of this T-shirt, at the feet of the victim and on the bedding along her feet.

Case 3: This case was a homicide of an 82-year-old woman with shotgun pellets. An autopsy of the victim revealed two gunshot wounds, one massive gunshot wound on the left forearm, and a lot of single wounds on the front side of the chest and abdomen (Figure 3). Based on autopsy findings and the degree of pellet scattering, a wound on the left forearm was inflicted from a discharge range of about 2 meters, while gunshot wounds on the torso were inflicted from a discharge range of about 18–20 meters. At some point during the autopsy, it was assumed that the left forearm was raised in front of the body, that the attacker did indeed shoot from a distance of about 2 meters, and that the gunshot wounds to the torso were caused by secondary scattering of projectiles on the left forearm bones. Analysis of gunshot residues couldn't provide a scientific answer, but BPA could clear this situation. To prove this, we conducted a detailed laboratory examination of the victim's shirt by a BPA expert.

The victim's shirt was colorful and extremely difficult to analyze, so in those situations, BPA uses the benefits of the infrared camera. An infrared camera helps BPA experts to clear out patterns of textiles and turn dark colors into bright ones, while bloodstains remain dark. Using this method, it has been shown that there are spatter patterns of bloodstains around most entrance wounds on the torso. Those spatters confirmed our theory that the pellets came to the torso together with the cloud of small blood drops. The source of blood for those blood drops was the gunshot wound on the left forearm.

After completing both autopsy and BPA expertise, it was concluded that there was a single shot from a close range, with a secondary scattering of pellets at the broken forearm bone fragments. At first, it seemed to be two shots, one from close range in the forearm and the other from a distance in the chest and abdomen, by the synergy of forensic autopsy and BPA revealed the true mechanism of injury.

Figure 3. A. General aspect of the victim with clothing; B. Massive gunshot wound of the left forearm and scattered pellet wounds on the front side of the torso; C. Close aspect of the shirt; D. Close-up aspect of the rupture on the front side of the shirt in infrared red camera live-view with dark blood spatters (note the bright clear color of the shirt)

Discussion

The organization scheme is very diverse across forensic laboratories worldwide, so it means there is still no perfect one. Authorities in the forensic science community have different views on writing reports by experts educated in different fields of forensic science. Also, some of those authorities have different opinions on the importance and proportion of generalist and specialist experts. Bigger laboratories have the privilege of having a wide range of different experts. Moderately sized laboratories have a limited number of employees, so it would be more appropriate to educate one forensic scientist in a few diverse fields of forensic science, but also in the basic principles of BPA (4, 5, 8–11).

A forensic pathologist and a BPA analyst are both interested in the wounds of a victim and bloodstains, and they are both involved in determining the manner and the mechanism of death, but based on different facts. They use different methodologies for different objects of interest, resulting in a similar final goal. By combining knowledge of those two forensic disciplines, we can gain an overall evaluation and more reliable facts about crime events. There are only a few experts in the world simultaneously educated in those disciplines. Our work presents the benefits of the holistic approach to violent death-related forensic expertise. BPA is grounded on principles of physics, biology, chemistry, and medicine. Rising out of those ground principles, it is clear that a forensic pathologist is the most suitable forensic scientist to be additionally educated in BPA (1–3, 6).

BPA is relatively new in Serbia in the form that it exists in leading world countries. For most judges and prosecutors this is something new. Most people are untrustworthy to new things, especially in new scientific areas. Recent scientific research revealed that conclusions in BPA reports were often erroneous (11.2%) and often contradicted other analysts (7.8%). Those results suggest a need for improved standards in BPA, but those results could be a consequence of insufficient knowledge of experts. Contradictory interpretations contributed to errors and disagreements, which could have serious implications if they occurred in casework. Confidence in BPA expertise could be obtained through strict standards, defined terminology, accredited education, and clear expertise by a BPA analyst (3, 5, 8).

Conclusion

BPA in Serbia is a relatively new forensic discipline. Police authorities (crime scene evidence technicians) in Serbia are familiar with BPA, but according to our legislation, they are not allowed to provide expertise in the courtroom. The benefits of synergistic expertise in forensic medicine and BPA are more than evident in our cases. Therefore, our work showed that educating forensic medicine specialists in the BPA is useful for solving suspicious and indistinct cases.

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Originalni rad **UDC: 340.6**
doi: 10.5633/amm.2025.0309

SINERGIJA SUDSKE MEDICINE I ANALIZE OBRAZACA KRVNIH MRLJA PRILIKOM ODREĐIVANJA PRIRODE SMRTI

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Specijalista sudske medicine i analitičar obrazaca krvnih mrlja uključeni su u utvrđivanje prirode i mehanizma smrti, s tim što se njihov naučni pristup razlikuje. U ovom radu predstavljaju se prednosti holističkog pristupa forenzičkoj ekspertizi. Analizirana su i opisana tri slučaja. Početna policijska istraga je u svim slučajevima ustanovila prirodu nasilne smrti koja je bila pogrešna (nesrećni slučaj, samoubistvo, ubistvo). Međutim, naknadnom sinergijom sudske medicine i analize obrazaca krvnih mrlja (engl. *bloodstain pattern analysis* – BPA) utvrđena je prava priroda smrti. BPA je u Srbiji relativno nova forenzička disciplina. Mada su policijski istražni organi (kriminalistički tehničari na mestu zločina) u Srbiji upoznati sa osnovnim principima BPA, naše zakonodavstvo im ne dozvoljava da obavljaju veštačenja u sudnici. Prednosti zajedničkog sudskomedicinog i BPA veštačenja više su nego očigledne u prikazanim slučajevima. Stoga, može se zaključiti da bi edukacija specijalista sudske medicine u oblasti BPA bila korisna u rešavanju sumnjivih i nejasnih slučajeva.

Acta Medica Medianae 2025; 64(3): 70–76.

***Ključne reči**: sudska medicina, obdukcija, krvna mrlja, analiza obrazaca krvnih mrlja*