



## **Full Length Research Article**

### **ANALYSIS OF BLOODSTAIN PATTERNS AT THE CRIME SCENE DUE TO ARTERIAL BLEEDING**

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#### **ABSTRACT**

This case study describes extensive arterial bloodstain patterns at the crime scene. It linked the accused to the time and place of the victim bleeding from the damaged artery.

#### **INTRODUCTION**

Arterial bleeding is described as projected patterns produced under pressure. It results from a force other than impact. An arterial pattern is seen when an artery is cut or severed. The projections of blood often cause a characteristic pattern of "rise and fall" corresponding to the diastolic and systolic pressure in the heart. The arms, legs and neck have arteries close to the surface that may project blood when damaged and unimpeded by clothing or other parts of the body. The structure and composition of the fabric of the garment always influences the appearance of any bloodstain on that garment. Clothing does not have the smooth, non-adsorbent surface as of walls and floors. So bloodstains may be distorted in shape. This distortion will depend on the fabric based on the absorption of bloodstains and the looseness of the weave, knit or felt of the garment material. It is required to find out the composition and construction of the clothing on any bloodstained garment for the evaluation of any possible arterial bloodstain patterns.

##### **Case Example**

Suppose accused 'A' and the victim 'B' shared in a flat. During the night of the offense in March 2015, gunshots were heard from the flat and the accused 'A' report to the police

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that victim 'B' had been shot. A .22 caliber pistol was lying near the feet of the victim. Police along with bloodstain pattern analysisist arrived and saw the accused outside the flat. Police entered the premises and found the victim on the floor of his bedroom with several gunshot wounds to his upper body. Bloodstains were present on the visible areas of his body and the front of his shorts. Arterial bloodstains were present on surfaces near his body, wall, a curtain and miscellaneous materials. The arterial patterns could be traced from the bedroom to the front room. Arterial patterns with altered flow patterns were observed on the inside of the front door. Bloodstain Pattern Analyst observed bloodstains on the back of his shirt that they considered as consistent with "arterial spurting". They also observed additional bloodstains on his yellow jeans and the top of his shoes. The accused informed to the analyst that he never saw the shooting and found the victim in his bedroom. On the next day police handed over photographs and autopsy report to the bloodstain analyst. The autopsy report described four gunshot wounds to the upper body. One bullet entered the left upper arm, perforating the left brachial artery and both lungs before lodging in the muscle behind the chest cavity. The death was determined to be due to multiple gunshot wounds and the victim exsanguinated in only a few minutes.

##### **Bloodstain Patterns at Crime Scene**

Bloodstain Pattern Analysisist interprets bloodstains based on properties of blood. Inside the body blood is in a liquid state. It

is also in liquid state when it exits the body. Blood will begin to clot within a few minutes. It formed a dark, shiny gel-like substance that grows more solid as time progresses. Bloodstains are three basic types: passive stains, transfer stains and projected or impact stains.

### Passive Stains

- Formed from the force of gravity acting alone
- Subdivided (drops, drip patterns, pools, clots)
- Oozing or gushes from the body, dripping finger or arm, drops from a knife

Different types of Passive Stains are shown in figure 1 to figure 3. Examples depicts bloodstain found in a crime scene from transfer or loss of blood by the victim. Blood dripping, contact with bloody objects, are further categorized as contact patterns, drip patterns, drip trails, blood pools or flows or blood clots.

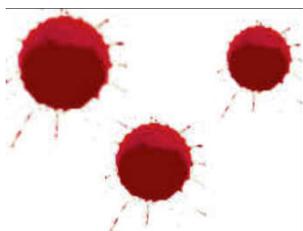


Figure 1.

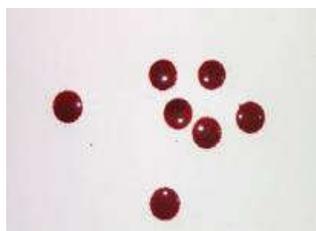


Figure 2.

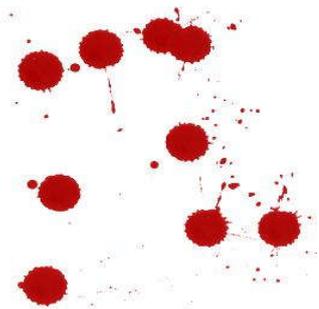


Figure 3.

### Transfer Stains

- Wet bloody surface comes in contact with a secondary surface
- Wipe, smudge, swipe or smear
- Finger smudge, wipe hand on clothing, shoe print, weave pattern on pants



Figure 4.



Figure 5.



Figure 6.

Various types of Transfer Stains are shown in Figure 4 to figure 6. Passive stains means drops, flows and pools resulted from gravity acting on an injured body.

### Projected or Impact Stain

- When exposed blood source is subjected to an action or force greater than gravity
- Internal activity (expired blood) or External force (stabbing, beating, gunshot)
- Subdivided
  - arterial spurt/gush
  - cast off stains: blood released from blood bearing object in motion
  - impact spatter: blood source receives a blow or force resulting in random dispersion of smaller drops

Various types of Transfer Stains are shown in figure 7 to Figure 9.



Figure 7.



Figure 8.



Figure 9.

Projected bloodstains are seen when an exposed blood source is subjected to an action or force, greater than the force of gravity. The size, shape, and number of resulting stains depend primarily on the amount of force utilized to strike the blood source.

## Categories of Blood Stains

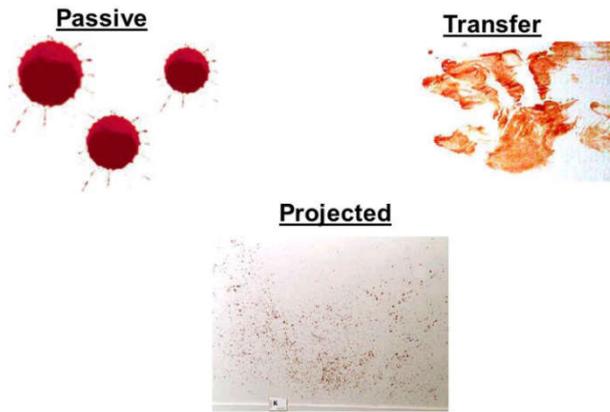


Figure 10. Categories of different bloodstain patterns

Categories of different bloodstain patterns are shown in the above Figure 10.



Figure 11.



Figure 12.

Distinctive blood patterns produced by breaching an artery of the body may be found at crime scenes. Arterial patterns are shown in Figure 11 and Figure 12.



Figure 13. Arterial bloodstain patterns on interior of front door

Figure 13 Arterial bloodstain patterns on interior of front door in a crime scene. Figure 14 Arterial bloodstain on wall. Gunshot spatter includes both forward spatter from the exit wound and back spatter from the entrance wound. Gunshot spatter will vary depending on the caliber of the gun, where the victim is struck, whether the bullet exits the body, distance

between the victim and the gun and location of the victim relative to walls, floors and objects. Typically, forward spatter is a fine mist and back spatter is larger and fewer drops. A bloodstain pattern caused by a high velocity impact/force to a blood source such as that produced by gunshot or high speed machinery. Blood spatter created from gun-shot wounds depends upon: the type of gun used, the area on the body that has been hit, the depth of penetration of the bullet and the distance at which the gun was fired from the victim. Close range shots to areas like the head, neck and heart tend to create the fastest travelling blood at the point of impact. These create very small spatters with messy edges and even misty spray. Blood dripping from wounds after the moment of impact has a lower velocity and creates dripped blood with neater edges. Gunshot spatter images are shown in Figure 15 and Figure 16.

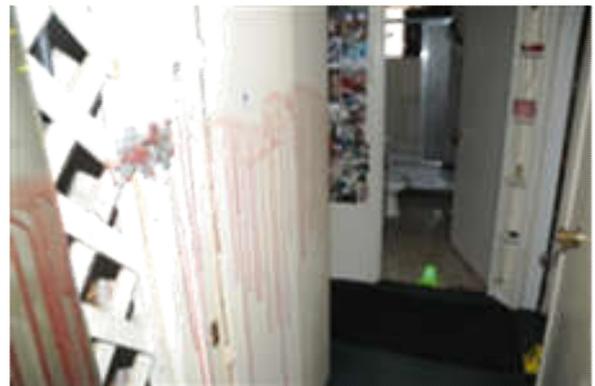


Figure 14. Arterial bloodstain on wall



Figure 15. in the floor



Figure 16. in the Kitchen



Figure 17. Passive Stain on cloth

### Review Works

Locard's exchange principle states that "every time an individual makes contact with another person, place or thing, it results in an exchange of physical materials" (Welding, 2012). The study of evidence at a crime scene is particularly based on

this principle. Bloodstain pattern analysis is defined as ‘the scientific study of the static consequences resulting from dynamic blood shedding events’ (Nordby, 2006).



**Figure 18. Transfer Stain on cloth**



**Figure 19. Projected Stain on Wall**

The detailed study of bloodstain patterns obtained from a crime scene could prove to be invaluable evidence for part/full crime scene reconstruction, in testing the credibility of the statements of the victim, suspect, bystander/eyewitness (if any). As per the International Association of Bloodstain Pattern Analysts (IABPA), a bloodstain pattern is defined as ‘a grouping or distribution of bloodstains that indicate through regular or repetitive form, order, or arrangement the manner in which the pattern was deposited’ (Scientific Working Group on Bloodstain Pattern Analysis, 2009). Based on the different case studies presented at the IABPA conference (<http://www.iabpa.org/journal>) the authors are of the view that of the different types of bloodstain patterns, the most common stain patterns visible at the crime scene, particularly in the case where the victim was found to suffer blunt force injuries, are saturation, impact, cast off and transfer stain patterns. In the IABPA Conference held in Tucson, Arizona, 2004, Peter Lamb presented the investigation report of the late night assault of a young man who was intoxicated at the time of attack and could only recollect part of the savagery that he had been subjected to (Peter Lamb, 2004). Due to rain drop that had soaked the garment at the time of the assault it was difficult to examine the bloodstains on the soaked garment (Scott Lamont, 2004). However there was evidence of kicking and stomping (Peter Lamb, 2004). Based on the evidence the case finally proceeded for trial and the accused was proved guilty and hence imprisoned (Peter Lamb, 2004). In his review of the Winds city homicide case Scott Lamont pointed out that barefoot transfer impressions and footwear transfer

impressions were found on the floor (Scott Lamont, 2004). Foot morphology confirmed that the prints were left by the suspect who was wearing boots (Scott Lamont, 2004). In the words of Lee Ann Singley, in the murder case of 2 women (74 year old mother and her 48 year old daughter) in their holiday home in a small town in Pennsylvania, while DNA evidence answered ‘who?’ in identifying the perpetrator at the trial, the bloodstain pattern evidence proved to be valuable to the jury in answering the ‘how?’ (Lee Ann Singley, 2006) To add to the list, in the case of Regina vs. Sion Jenkins, expired and other bloodstains on clothing were used as relevant evidence within the legal setting to acquit Sion Jenkins of the murder of his 13 year old daughter Billie Jo (Joe Slemko, 2007). In the case presented by Paul Treudson, at a particular crime scene bloody transfer impressions of an apparent right hand holding a knife was found on top of a sheet that lay at the foot of the (Paul Treudson, 2007). The impressions included knuckles and a blade (Paul Treudson, 2009). As Erin Sims puts it, for one particular case the evidence particularly the bloodstain pattern evidence was the only honest teller of the course of events that had led to the victim’s injury (Erin Sims, 2008).

### **Role of Bloodstain Pattern Analyst**

Blood stain pattern analysts' primary role is the collection and analysis of physical evidence, in this case blood. Bloodstain pattern analysts examine the location and shape of blood drops, stains, etc. Bloodstain pattern analysts use their expertise to determine:

- Type of weapon used
- Direction of travel of a victim or suspect
- Trajectory of a projectile
- Number of wounds a victim may have suffered
- Find events unfolded during a violent crime
- Responding to crime scenes
- Interacting with bio hazardous material (blood and body fluids)
- Taking photographs
- Collecting samples
- Writing reports
- Testifying in court if necessary

The recognition and analysis of bloodstain patterns in a criminal investigation is to reconstruct of those events of an alleged incident based on stains and stain patterns present at a crime scene, physical evidence recovered from that scene and on items of clothing that were present at the crime scene. In some cases, they conduct a bloodstain pattern interpretation utilizing photographs. The usefulness of individual bloodstains and bloodstain patterns lies in their retention of information descriptive of the possible events that could have produced them. The sizes of the individual stains composing a pattern, the shapes of these stains and their distribution relative to one another can be utilized for the purposes of determining how a particular stain or pattern may have been produced. Bloodstain pattern analyst determines what action(s) or sequence of actions could have created the bloodstains and/or patterns observed. Information that may be gained with bloodstain pattern analysis include, for example, the position of the individual when the blood was deposited (sitting, standing, etc.), the relative position of individuals at the time of bloodshed, the possible type of weapon used as well as possible mechanisms that could have produced the blood

staining on a surface. The crime scene analyst applies each category of evidence to the situation without inferring the situations as far possible, but recognizing the whole. These evidences establish a knowledge base from which the analyst reaches the "truth". The information we are likely to discover through an examination of the bloodstains includes:

- Find the direction of droplet at the time of impact
- The angle of impact
- The estimated distance from the target to the droplet occurred due to heat by blunt force.
- The nature of the force involved in the bloodshed and the direction from which that force was applied.
- The nature of any object used in applying the force.
- Assume the number of blows struck during an incident.
- Positional view of the suspect, victim, or other related objects during the incident.
- Consider multiple events associated with an incident.
- To understand which hand delivered at the time of heating to victim.

Bloodstain pattern analysis brings to the investigation the ability to define those events that could or could not have occurred during the course of bloodshed. Once identified, these facts are considered in light of all other evidence as a means of corroborating or refuting statements, confessions, or investigative theories. For example, in describing a pattern transfer as "consistent with" something, any analyst should be able to point to some physical characteristic of the stain and then to the correlating item that created it. The analyst should then be able to create some generalized reproduction of the pattern using the item.

#### Views of Bloodstain Pattern Analyst for Case

Based on blood stain found at the above mentioned crime scene, Blood stain Pattern analyst is sure that suicide seemed unlikely. Blood was coming from the front and back of victim 'A' head and body (a very awkward place to shoot himself). They also found the victim on the floor of his bedroom with several gunshot wounds to his upper body. They also noted that accused 'B' had some of victim blood on his pants. Accused claimed that this was from victim, however the pattern was not consistent with this claim. The blood was a high velocity pattern which is consistent with a gunshot wound. They determined that victim must have been shot while sat on the floor, leaning on the bed, the blood on the side of the sheets showed this. They also determined that the blood on victim's hand was from contact with the blood on the floor. The shot to the top of the head, gunpowder and soot under skin and in wound were found in the spot. It is shown in Figure 20.



Figure 20. Victim is lying on the floor

While the bloodstains are important to interpret, these must be examined in every detail of the body and entire room carefully. The bloodstains shown on the wall, on the door and on the

front and back of the victim's head appear to be consistent with the theory that he was shot number of times in the head and body while he was down. Bloodstains were present on the visible areas of his body and the front of his shorts. Arterial blood stains were present on surfaces near his body, wall, a curtain and miscellaneous materials. The arterial patterns could be traced from the bedroom to the front room. Arterial patterns with altered flow patterns were observed on the inside of the front door. It is observed bloodstains on the back of accused shirt that they considered as consistent with "arterial spurting". They also observed additional bloodstains on his jeans and the top of his shoes. The accused initially claimed that he never saw the shooting and found the victim in his bedroom.

The Blood stain Pattern Analyst observed the following during investigation of the case:

- The autopsy report described four gunshot wounds to the upper body. One bullet entered the left upper arm, perforating the left brachial artery and both lungs before lodging in the muscle behind the chest cavity. The death was determined to be due to multiple gunshot wounds and the victim exsanguinated in only a few minutes.
- The arterial bloodstain patterns and altered flow patterns on the inside of the front door were created when the victim was within the apartment and the door was closed or was in the act of closing. He bled from the entry wound in the left upper arm onto vertical surfaces in the front room and entrance of the hallway producing arterial bloodstain patterns.
- The victim then moved through the hallway creating arterial bloodstain patterns on the left side of the wall as he entered into his bedroom and collapsed on the floor. There were no interruptions observed in the arterial patterns along the hallway wall, which was significant in interpreting the bloodstains on the clothing of the accused.
- Bloodstain patterns with the distinctive morphology of arterial bloodstain patterns were observed on the back of the shirt of the accused.
- Drip stains were noted on the top surfaces of both of his shoes.

It was concluded that these bloodstain patterns were deposited on the clothing of the accused when the victim was bleeding from the gunshot wound that perforated his left brachial artery. The accused was standing upright near the victim either in the front room or in the bedroom when the victim projected blood onto his clothing, as there was still sufficient pressure from the artery to reach the upper back area of his shirt. Arterial bleeding can often be distinguished from venous projection due to the lower amount of pressure in the venous system. Cases of chronic venous insufficiency syndrome with hemorrhage may also produce similar patterns, but these are observed more on the lower walls and floor where the hydrostatic pressure is high in the legs. Nevertheless, it is imperative to ascertain at autopsy that an artery was severed and this can then be correlated with confidence to the projection patterns observed. Complex patterns of small spatter can also occur at a scene with arterial bleeding. Small spatters are frequently associated with arterial spurts in addition to the more classical large volume projections with typical downward flow patterns on a vertical surface. Spine-

like satellite spatters are also commonly observed within arterial patterns. Bloodstain pattern analysts have recognized that there is an overlap between blood patterns produced in what was traditionally termed high, medium and low velocity events; and thus terminology has been adopted to incorporate stain morphology relative to mechanisms that may have produced them, with medical history and scene related facts. The analyst should be careful not to over-interpret each and every stain of a pattern and analyze the pattern as a whole, still recognizing that there may be overlapping mechanisms. Finally analyst found accused 'B' murdered victim 'A' based on blood patterns, gun shot on victim head, blood on cloth of accused and Arterial patterns present on the body of the victim.

### Conclusions

If bloodstain patterns are initially observed on the accused and then it is easy to examine for pattern analysis. The flow of the Arterial bleeding should also be considered as this may impact on the morphology of the observed bloodstains. The bloodstain patterns on the clothing of the accused, the blood patterns at the crime scene, and the autopsy examination can then be correlated for a scientifically defensible analysis.

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