8.12 Blood Patterns

8.12.1 Categories of bloodstains

There are three general categories of bloodstains; each one is defined and described in terms of the force required to form the pattern that is observed.

1. Passive.
2. Transfer.
3. Projected.

Again, we must describe the forces acting on bloodstains and not the bloodstains themselves. Therefore, passive bloodstains are bloodstains formed by gravity as the only *external* force acting on the bloodstain. In reality, all passive stains are a combination of gravity and adhesion with the resulting bloodstain formed by the blood adhering to the contact surface.

Passive bloodstains include drops, drips, clots and pools.

Transfer bloodstains are created when the principle acting force to cause the stain is adhesion only. If an object encounters something bloody, blood will pass between the two objects through the process of adhesion. Transfer stains differ from passive stains by having no gravity component to their formation.

Transfer stains can be further subdivided into contact bleeding, swipes, smears, wipes or smudges.

Projected stains are caused when a force greater than gravity acts to create the bloodstain. Projected stains can be further divided into spurts, cast-off stains, impact stains or spatters.

8.12.2 Directionality of bloodstains

Blood falling in a direction perpendicular to a surface will leave a rounded bloodstain. It will be circular (see Fig. 8.10).

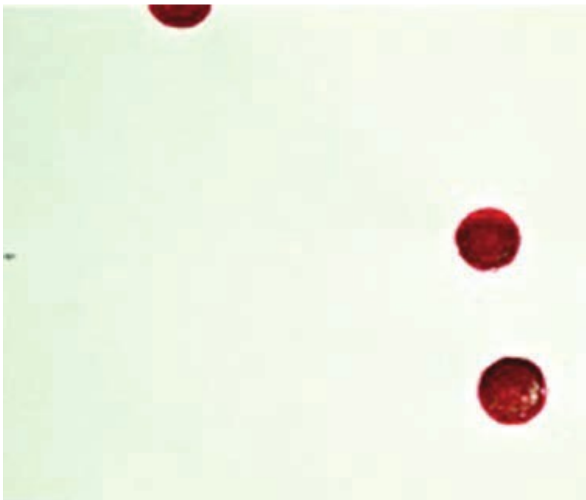

Fig. 8.10. Bloodstain falling from a short height onto a paper surface with little or no edge distortion.

For a bloodstain caused by blood falling from the end of a needle onto the paper, the external forces acting are gravity and adhesion. There will also be a level of distortion to the drop, depending on the type of surface the blood lands upon. The material of this surface and the elasticity of this surface will affect the final shape of the visible bloodstain.

Directionality of a bloodstain can be indicated by the bloodstain pattern observed that has adhered to a surface.

The ‘pointed’ end of the bloodstain assists in determining from what direction the blood travelled. The telltale finger-like projection at the end of the bloodstain points in the same direction of travel and away from the point of origin.

8.12.3 Point of convergence

Once the directionality of a bloodstain has been determined, it is then possible to determine the directionality of a group of bloodstains. By drawing a line through the long axis of a group of bloodstains, the point of convergence can be determined.

8.12.4 Number of bloodstains required to make an observation?

The number of bloodstains required to interpret or form a conclusion upon is as many as the expert feels is relevant or appropriate. There is no minimum number of bloodstains required to make an interpretation.

Case Study 8.1 Regina versus XY

The defendant was charged with the offence of stag-carting. It was alleged that the defendant transported two stags to a location for the purpose of releasing and hunting them on horseback. The deer were born and raised in enclosed premises and transported and released for the purpose of hunting them.

At the point of this dispute was the domestic nature of these animals. Wild animals are not covered by the animal welfare act in Northern Ireland; however, this act extends to domesticated and captive animals.

The animals were loaded onto a trailer and transported and released for hunting. The hunting involved the pursuit of these animals on horseback by members of an organized hunt. Hounds followed and often the deer involved would escape into the environment.

A trailer was seized, and evidence collected from it included deer hair, deer antler and blood. The defendant claimed that the trailer had not been used for this purpose before and the trailer was cleaned prior to each use.

A number of bloodstains were identified in the trailer. These stains were interpreted by the prosecution expert as an indication of bleeding during transit. A number of stains indicated cuts that occurred in transit and demonstrated that the transported deer may have fallen over during transit.

Bloodstains that were overlaid by mud stains demonstrated a temporal sequence to the bleeding.

The bloodstains in the trailer indicated to the prosecution expert that the deer had bled in transit and therefore had suffered during transit. The suffering was not at issue, but the necessity of the suffering was argued. The deer *had to* be transported to be released to be hunted. It was argued that this suffering as evidenced by the bloodstains in the trailer was unnecessary.

8.13 Bruises

> Bruise – superficial discoloration due to hemorrhage into the tissue from ruptured blood vessels beneath the surface of the skin without the skin itself being broken.
>
> (Blood and Studdert, 1999, p. 163)

Assigning any forensic significance to bruises in animals can be problematic, due to the lack of visibility of animal bruises. There are very few studies focusing on bruising in animals and the problems inherent to biological systems of variability of presenting signs describing a bruise in a living or dead animal.

These problems are exacerbated by hair covering the skin, thick skin in some species (cattle) preventing visibility of any bruising, as well as deeply pigmented skin in many animals, which further reduces the visibility of bruises.

The mechanism of bruising is the same in animals as in humans – bleeding under the skin into the tissue without the skin being broken. The colour changes seen in bruises are due to the breakdown of the red blood cells and their functional component – haemoglobin. Blood in new bruises is a red colour. As the haemoglobin breaks down and loses its ability to retain its shape, it becomes converted to biliverdin, which is green in colour. This breakdown progresses to bilirubin, which is yellow in colour. And this in general follows the breakdown process and subsequent age process of a bruise in the skin of a non-pigmented animal.

Langlois and Gresham (1991) examined 369 photographs of 89 human subjects (age range 10–100 years, grouped into <65 years and >65 years) presenting to a casualty department (in addition to staff and in-patients) with bruises, the age and cause of which was known. A standard colour chart was included, and in some, but not all cases, repeat photographs were taken.

The key finding of this study was that yellow was not seen in bruises less than 18 h old, but that not all bruises developed this colour before resolving, and so a bruise without yellow colouring could not be said to be less than 18 h old.

They also indicated that the colours in bruises were dynamic, and could ‘reappear’ days later, and that separate bruises on the same person, inflicted at the same time, did not necessarily exhibit the same colours, nor undergo equivalent changes in colours over time.

Skin colouration affected the evaluation of bruising, and the study findings were therefore limited to white-skinned human individuals.

Following this study, Munang *et al.* (2002) looked at bruises in children, and observers were asked to describe the predominant colour *in vivo*, and then again later from a colour photograph. Inter-observer variation was also assessed. They found that in only 31% of cases was there complete agreement of colour description by the same observer, between the *in vivo* examination and assessing the photograph. Agreement between observers for a bruise examined *in vivo* was seen in 27% and between photographs of the same bruise in only 24%.

In only one in ten bruises examined at the same time and in the same place did three individuals completely agree as to the predominant colour seen.

Reliance on the colour yellow was thus beginning to be questioned, and Hughes *et al.* (2004) showed subjects a series of photographs of bruises in which the yellow 'saturation' was digitally altered, in order to evaluate differences in yellow perception. They found that there was a variability in yellow perception and that an individual's ability to perceive yellow declines with age. All subjects used in this study had normal colour vision, as assessed using Ishihara plates (the standard tool used to assess colour blindness in children).

8.14 Qualifications to Give Testimony on Blood Spatter and Blood Pattern Analysis

While qualifications vary, courts are willing to hear evidence from experts on seemingly minimum bases (James *et al.*, 2005).

Evidence may be admitted to the court; however, the weight the evidence will be afforded will be determined by the experience, skill, knowledge and training of the expert.

8.15 Ante-mortem versus Post-mortem Injury

Existing forensic techniques are limited in their capability to deliver an accurate assessment of when a wound was inflicted. Wounds can be delivered to a body after death as well as prior to death. This can be due to the action of scavenging animals or, in some cases, the wounds can be deliberately or accidentally inflicted. A dead animal that has autolysis of the external cells can have its hair and skin slough off quite easily from handling while picking it up, and this will need to be differentiated from an ante-mortem wound. Bodies that are buried in a shallow or partial grave can be punctured with a search rod used to find them.

Oehmichen *et al.* (2009) at University Hospital of Schleswig-Holstein in Kiel, Germany, found that counting the number of mast cells at a wound margin can assist in determining whether a wound has been inflicted pre- or post-mortem.

In a living body, if tissue is damaged then many white blood cells, including mast cells, are preferentially diverted to the area through the inflammatory process. The mast cells assist in wound healing by release of granules to assist in new tissue growth and dead tissue destruction. After release of this enzyme, the mast cells lose the ability to make an enzyme called chloracetate esterase, so they will no longer show up when examined microscopically with a dye.

Consequently, a gradient of mast cells is seen microscopically, with the wound margins having less or no visible mast cells and the undamaged areas of the wound with a greater number of mast cells. Any wounds inflicted post-mortem would have no mast cell enzyme release and so, under the dye the researchers used, there would be a uniform distribution of mast cells from wound edge to wound body, indicating a post-mortem-inflicted wound.

Case Study 8.2 Bruising in Animals

Bruising can age a wound clinically, but not forensically. Bruises change colour after death. Here is an example of how bruising can change in a dead animal and how incorrect storage of the animal can lead to bruising colour changes.

In this example, the dog was euthanized after sustaining a dog bite. The animal was photographed immediately after euthanasia (see Fig. 8.11).

The dog was autopsied some time later and the visible colour changes in the external appearance of the skin and bruises were attributed to ante-mortem wounds in the animal (see Fig. 8.12).

The message from this example is that bruising in non-pigmented animals can be used as a clinical indicator (only) and should not be used as a post-mortem finding to interpret wound age.

Fig. 8.11. Note the colours of the bruising that ranges from red and blue to areas of yellow discolouration.

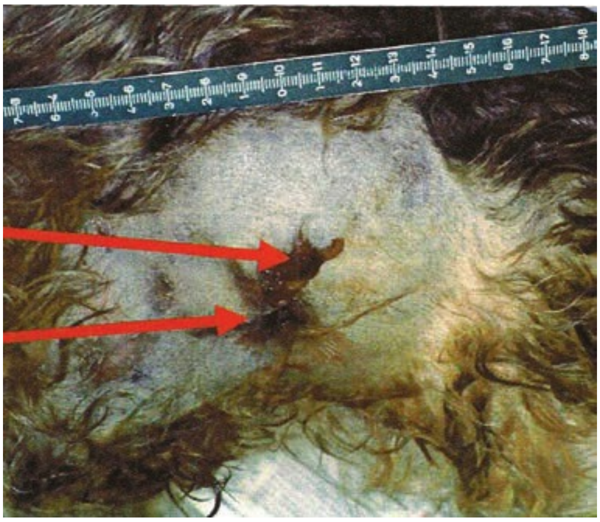

Fig. 8.12. In this image of the same animal, the post-mortem alteration of the skin should not be attributed to any ante-mortem condition in the animal.