



THE  
ESSENTIALS  
OF  
FORENSIC MEDICINE

By  
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ESSENTIALS OF FORENSIC MEDICINE



THE TOLLUND MAN  
An Iron Age Ritual Murder? (Page 18)

## P R E F A C E

THIS book is an amplification of lectures delivered in the University of Leeds and it embodies experience gained through participation in a pathology service for the Home Office and for certain H.M. Coroners in Yorkshire.

It is intended, in the first instance, to meet the needs of undergraduates in medicine and in law. Resident hospital medical officers and general medical practitioners, however, are not rarely faced with duties and problems with which this book deals. Although the medico-legal expert may find its contents add nothing to his knowledge, the hospital pathologist, preoccupied with clinical problems, may turn to its pages for help when called upon to act as a medico-legal expert. Amongst the laity there are many who encounter medical evidence in the course of their duties. Coroners, magistrates, barristers, solicitors and police officers, therefore, are in mind and it is hoped that for them the present account of the subject has something to offer. It is also believed that much of the contents of the book is relevant in all civilized countries. The signs of death, modes of identification, a cut throat or a broken skull are not dependent on any particular system of law.

The information is in textual form, without pictorial aids or "classifications", because the aim is to focus attention on the text. Omission of the usual chapters on toxicology is also deliberate because that subject demands separate treatment and another book, on clinical toxicology, is in preparation.

The present endeavour has been to provide a reliable and up-to-date account of forensic medicine in readable form acceptable to medical and lay readers alike.

There has been no attempt to offer a complete or even a comprehensive bibliography. At the same time facts and opinions derived from others are duly acknowledged and the reader is also directed, as required, to authoritative sources which will provide a fuller account of the subject under consideration. Cases from my own Department's practice are indicated by the inclusion of their serial reference number in the text (e.g. F.M. 2056).

To  
MARY, my wife,  
and to  
R.A.W.

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## THE SIGNS OF DEATH

It is difficult to define death precisely. It presents in two phases, namely the extinction of personality or somatic death, which is usually implied when we speak of death, and, secondly, the disintegration of the body tissues or molecular death. Gonzales, Vance and Helpert (1940), offer this definition of death: Life is the process which preserves the physical integrity of the body; death is the stopping of that process, so that when life is extinct, the body begins to disintegrate.

Although the event of somatic death is usually obvious, a consideration of its signs is necessary because suspended animation may closely simulate true death. The signs of death, moreover, permit estimation of the time at which death occurred and this may be of importance, especially in criminal circumstances. The police will wish to know not only that a victim is dead but also when he died.

**Suspended Animation.**

Suspended animation may be induced voluntarily. A Colonel Townshend is reputed to have been able to pass into a state of pulselessness for nearly half an hour. When doctors had left him as dead, one of them who turned back was surprised to see that the patient showed signs of life.

Practitioners of Yogi can also pass into a trance, death-like in character. Similar trances are sometimes observed in the insane. One patient, although clearly alive, for months lay like a log, showing signs of slight animation only at meal times. She then opened her eyes and permitted the passage of the stomach tube by which she was given milk.

Involuntary suspension of animation is of far greater practical importance. It is a common experience to find that newborn infants show no obvious signs of life. They may remain in this state for several minutes and will die unless prompt action is taken. Recovery has followed insufflation, even though suspended animation persisted for twenty minutes.

Persons who have been submerged are likely to appear to be dead when rescued. The rescuers often suspend their attempts at artificial respiration at the end of a few minutes. If, however,

they persist for an hour or even longer, they may succeed. Payne (1940) has stated that success is possible when the victim has been submerged for as long as half an hour. It would seem that ancient superstition led to the belief that it was unlucky to resuscitate the drowned; it may continue to be believed by some.

Experience in electrocution is similar. The Chief Inspector of Factories (1946) reported that too often rescuers suspended resuscitation within a quarter of an hour, whereas recovery of those apparently dead followed when resuscitation had continued for as long as two hours. He found that although recovery, if it were to occur, was usual within ten minutes, several victims did not show signs of recovery until the end of twenty minutes. Absence of signs of life at twenty minutes generally indicates death, but a few persons recovered after longer intervals.

It is likely that when obese persons, or those with thick-walled chests, are involved in an accident, their heart-beats may be imperceptible for a time immediately after the accident, which may cause temporary circulatory depression.

The "typhoid state" may also resemble death.

It does appear that spontaneous movements of the feet and legs can occur after death. Badonnel *et al.* (1936) observed such movements at thirteen hours after death; they are also said to occur after death from cholera or yellow fever. These authors suggest that the movements are due to accumulation of carbon dioxide in the blood and, possibly, the muscles.

The practical importance of suspended animation is best brought home, perhaps, by mistakes which are not without a humorous aspect. A man aged eighty-three, near Brussels, attempted suicide by smothering. He was certified as dead and was taken to the mortuary. When the undertakers arrived to place him in his coffin he was found seated on top of it, not only alive but very hungry. He is reported to have walked home unaided. His relatives had sent out death notices and had bought wreaths (*Daily Mail*, September 14th, 1948).

Survival after suspended animation is not normally more than a few minutes or hours, as is illustrated by the case of a man aged sixty-four, who was presumed dead after an accident in a colliery, and had been conveyed to a mortuary. Signs of life were then apparent and he was at once transferred to hospital but died during the journey (*Yorkshire Evening News*, Dec. 31st, 1948).

It is therefore unwise to presume death until sufficient evidence makes this conclusion beyond reasonable doubt. The following

experience, related to me by one of the doctors concerned, illustrates the difficulties which may arise.

Two doctors, both experienced physicians, were driving behind an omnibus which ran over a child. They went to the scene and found the child lying under the front wheel of the bus; she was black in the face and appeared to be dead. Of this they were quite certain. It was impossible to extricate the child until the vehicle was reversed to set her free, a step which the driver took only after considerable persuasion. As soon as she was released, the child immediately showed signs of life. She was taken to an adjoining shop and, a few minutes later, she was found about to be given a drink. This the doctors forbade as they felt sure that rupture of viscera had occurred. The child was taken to hospital and, after a day or so, made a complete and uneventful recovery.

### **Signs which Appear immediately after Death.**

Within a few minutes of death, the changes which will be noted are as follows:

(i) *Pallor and loss of elasticity of the skin.*

(ii) *Ocular signs:* these include absence of the corneal and light reflexes of the eyes, cessation of circulation in the retinal vessels and reduction in intra-ocular tension. Gentle pressure on the globe will compress the iris and cause the pupil to become irregular; this change does not occur during life but is present within twenty-four hours of death (Tonelli, 1932; Joll, 1881).

Tâche noir de la sclérotique is also an ocular sign of death, but is rarely apparent until at least a few hours have elapsed, and may not appear until two days after death. It is seen only when the eyelids have remained open after death. The spots may be round or oval but are usually triangular, based directly on the cornea and more often on the outer than the inner side of the globe; that on the inner side develops, as a rule, after the appearance of the outer one. At the outset the spots are usually yellowish in tint, becoming brown and, later, black in colour. The spots are due, possibly, to desiccation of the tissues but not, as was originally believed, due to thinning of the sclera whereby the choroid becomes visible. There may be, however, some change which renders the sclera translucent.

Niderkorn (1872) refers to Larcher's account of this phenomenon published in 1862 but points out that these observations were not the first since the change had been described by Sommer (1833) and even if Larcher had not seen or read this earlier account, in Latin, he could have read its translation by Jourdan, in Burdach's *Traité de physiologie*.

(iii) *Flaccidity (primary) of the muscles.* The limbs become flaccid after death and the body flattens over areas which are in contact with the surface on which it rests. Contact flattening, as it is termed, is usually seen over the shoulder blades, buttocks and calves. Since, at this stage, death is still only "somatic", response of muscles to electrical stimuli can occur and may persist until "molecular" death, i.e. of the individual tissues or cells, takes place.

(iv) *Cessation of Circulation.* Pulselessness is an unsafe indication of death for the apparently dead may be pulseless for half an hour.

Absence of heart sounds, as determined by repeated auscultation, during a period of not less than five minutes, is usually sufficient proof of death. Care is necessary to exclude error occasioned by obesity, feeble heart action and slow rhythm, which may be reduced to only twelve beats per minute.

Subsidiary tests, which are rarely used, include the ligature test, fingernail test, finger web inspection by transmitted light and the injection of fluorescein. It should be recalled that the yellow green tint of the skin produced by fluorescein in the living is to be detected only in daylight. Testators sometimes direct that one of their arteries shall be opened after death. None of these tests is necessary if auscultation is repeated by an experienced person.

Suspended animation, when accompanied by reduction of the cerebral circulation, will result in death if an adequate flow is not restored before the end of ten or at most twenty minutes; the prospects of complete recovery of the patient are remote when this interval exceeds five minutes.

(v) *Cessation of Respiration.* The demonstration of this also calls for repeated auscultation during a period of not less than five minutes. Apnoeic intervals, as in Cheyne-Stokes breathing, are limited to about twenty seconds.

A number of subsidiary tests are described, for example the mirror, feather and candle tests, but these are unlikely to be used except by the laity.

### **Other Changes which Appear During the First Twelve Hours after Death.**

(i) *Cooling of the body.* This remains "one of the most prominent early signs of death" (Sydney Smith and Fiddes, 1949). The determination of body temperature by touch is not unknown even today, although it should be common knowledge that the hand is an inaccurate guide. A thermometer is required and one which

measures a temperature range within the limits of from 60°F. to 120°F. The temperature should be taken in the rectum and the thermometer should be inserted at least three inches and left there for at least two minutes, before a reading is taken. When assessing the time of death, it will be remembered that the normal rectal temperature is approximately 99°F. or 0.5°F. higher than the mouth or axillary temperature. Determination of the temperature of the body by readings taken in the axilla is not recommended; the rectal reading is alone satisfactory. When this is at or below 75°F., death may be presumed.

Cooling of the body normally begins at the moment of death and a relatively rapid fall occurs during the first three to six hours; there is a further moderate fall during the next six hours and thereafter a slow fall until the body attains atmospheric temperature, i.e. that of its surroundings. When the body is unclothed the rate is by about 2° to 2½°F. per hour in the first, 2°F. per hour in the second period and thereafter by about 1° F. to 1½°F. per hour, up to the end of eighteen hours.

Although the body temperature is capable of precise measurement and its determination is still a principal means of estimating the time of death, it is only an approximate criterion. The rate of fall can be modified by one or more of several factors. It will be more rapid when the difference between body and air temperatures is high. It is faster in the bodies of infants and the aged than in the young adult; in the emaciated than in the obese. The rate also depends upon the amount of covering, by clothing or bedding, applied to the body. A well-clad body in cold weather may still be as much as 10°F. above the temperature of its surroundings even at the end of forty-eight hours (Sydney Smith and Fiddes, 1949). Cooling is delayed when the death is due to asphyxia and for this reason, also, in cases of strychnine poisoning. Pyrexial disease may yield a post-mortem temperature above normal. Submersion, on the other hand, hastens cooling, the rate of fall being almost twice as fast as by air cooling. Cholera, stated to cause a post-mortem rise, may, more probably, be the cause of a sub-normal temperature.

Despite these factors, the body temperature remains a valuable aid which, taken in conjunction with bio-chemical examination of the cerebro-spinal fluid, provides the best possible estimate of the time of death of a person recently dead. Camps (1954) demonstrated a portable apparatus for the electrical determination of body temperature; this instrument is as yet under trial but it is likely to have value.



(ii) *Post-mortem Hypostasis* (Lividity or Suggilation). When somatic death occurs, circulation of the blood ceases and subsequent movement of the blood is by gravitation. In consequence, blood tends to accumulate in the capillaries and small veins in the dependent parts of the body. Filling of the subcutaneous capillaries in this manner imparts a purple or reddish-purple colour to the adjacent skin, a change to which the term "post-mortem hypostasis", lividity or suggilation, is applied.

Pressure of even mild degree is sufficient to prevent gravitation of blood into the compressed areas of "contact flattening". When laid on the back, the body has pale areas over the shoulder blades, buttocks and calves. Corresponding areas are present when the body lies face-down. Contact flattening also occurs at the site of garters, a belt or collar when worn at the time of death.

Hypostasis in bodies exposed to the air may acquire a pink colour, due to oxygenation of the blood, i.e. at the sides but not, as a rule, at the back or other areas which are close to the ground. This colour of the hypostasis might suggest a death from carbon monoxide poisoning. The distinction is readily made by inspecting the dependent areas, i.e. at the back, or front of the body, according to its position, for these also will be pink when death is due to carbon monoxide poisoning.

The external appearances receive the major attention but hypostasis occurs also in the viscera and provides some confirmation of the external observations. More important, there is need to remember its occurrence in the viscera, lest the appearances be regarded as pathological changes, which may thus be simulated. Hypostasis in the heart can simulate the effects of coronary occlusion and in the lungs it may suggest pneumonia; dependent coils of intestine might seem to have been strangulated.

The practical value of hypostasis is threefold; it is, firstly, a sign of death; secondly, its extent is a subsidiary means of estimating the time of death; and, thirdly, the most important feature, it provides information concerning the position of the body after death.

Hypostasis, although it varies in its time of onset, is ordinarily apparent within half an hour after death, and its complete development is attained in from six to twelve hours; it usually becomes permanent at the end of about eight to twelve hours, by which time the blood has coagulated. It is said sometimes to occur shortly before death, e.g. when due to cholera or typhus; this may also occur when the death is lingering, as in the debilitated and those who die of uraemia. Its onset is hastened in the tuberculous body and delayed when death is due to anaemia or some acute pyrexial