



Death caused by a chain saw – homicide, suicide or accident?

A case report with a literature review (with 11 illustrations)

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Abstract

A 31-year-old farm worker was found dead beside a chain saw. Based on the testimony of a colleague and because of the situation at the site, the police very soon presupposed an accident. It was assumed that the victim had slipped on the sodden ground and had been killed by the subsequent swerving of the saw when starting the engine. The body presented with a deep lacerated wound at the right side of the nape of the neck, including the first cervical vertebra, the medullary canal and the right mandible as well as multiple fissures of the occipital bone, which were attributed to repeated forceful use of the chain by another person. A second wound with relatively sharp edges and a tangential fissure in the corresponding area of the skull raised the suspicion that an axe or some similar device had been used. Although the forensic medical findings seemed to give clear evidence of external violence, no further investigations have been carried out so far by the authorities. © 1999 Elsevier Science Ireland Ltd. All rights reserved.

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1. Introduction

Reconstruction of the sequence of violent events by comparing wound morphology

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and the tool possibly utilized to inflict an injury, including consideration of biomechanical and technical aspects, is one of the classical tasks of the medico-legal expert [1,2,6,8,13]. He also needs to know the criminalistic findings to determine whether the incident in question occurred through the action of another person or by accident. Not infrequently, autopsy reveals surprising findings, as demonstrated by a case of lethal injury caused by a chain saw.

2. Case report

2.1. Situation at the site

One morning in late October, the lifeless body of a 31-year-old farm worker stemming from Bosnia was found next to the stable of a farming estate by one of his colleagues (Fig. 1). The body was lying on a chipwood board that was covered by a layer of wet leaves. The finder told the police that he had heard the engine noise of a starting chain saw and had run to the source of the noise, where he found his colleague beside a motor saw lying to the left and above the body. The injured man died immediately on the site where he had been discovered. When the police arrived, the back of the head rested on a piece of rock measuring approx. 40×60 cm, which jutted out from the ground for about 10 cm and showed blood-like adhesions (Fig. 2), particularly below a sharp edge



Fig. 1. Situation of the body at the time of police arrival. Note the chain saw beside the left upper part of the thorax and neck (arrow marks traces suspected as signs of sliding on a chipwood board).



Fig. 2. Head of the victim resting on a rock with wet leaves all around and underneath the body. Note small blood trace on the face above the chin (arrow).

measuring about 8 cm in width and standing out from the rest of the level. The chipwood board showed a trail of wet leaves pushed together beside the region of the left knee of the body (arrow in Fig. 1). This was thought to be evidence that the man must have slipped. A strip-like adhesion of blood tapering off to the left was located on the part of the face above the chin (arrow in Fig. 2). Footprints found in the sodden ground in the immediate vicinity were identical with the profile of the dead man's shoe soles. The clean clothes, the stretched position of the body, and the positioning of the hands upon the upper abdomen seemed to be remarkable. No hints pointing to any involvement of another person were disclosed in the course of the preliminary police investigation.

2.2. Technical characteristics

Unfortunately the chain saw had not been confiscated by the police for technical examination, so that only blurred polaroid photographs of the site were available for further analysis later on. In one of these photographs (Fig. 3) an expert identified the chain saw as a STIHL 044 model. Adhesions of blood extended from about the middle of the saw blade in a partly spatter-like course upwards to the proximity of the engine's housing, and they were concentrated on the underside of the blade.

The technical data of the saw are as follows: engine power 3.8 kW (5.2 horsepower), cubic capacity 70.7 cm³, mass 6.0 kg, electronically controlled ignition, quick-stop chain

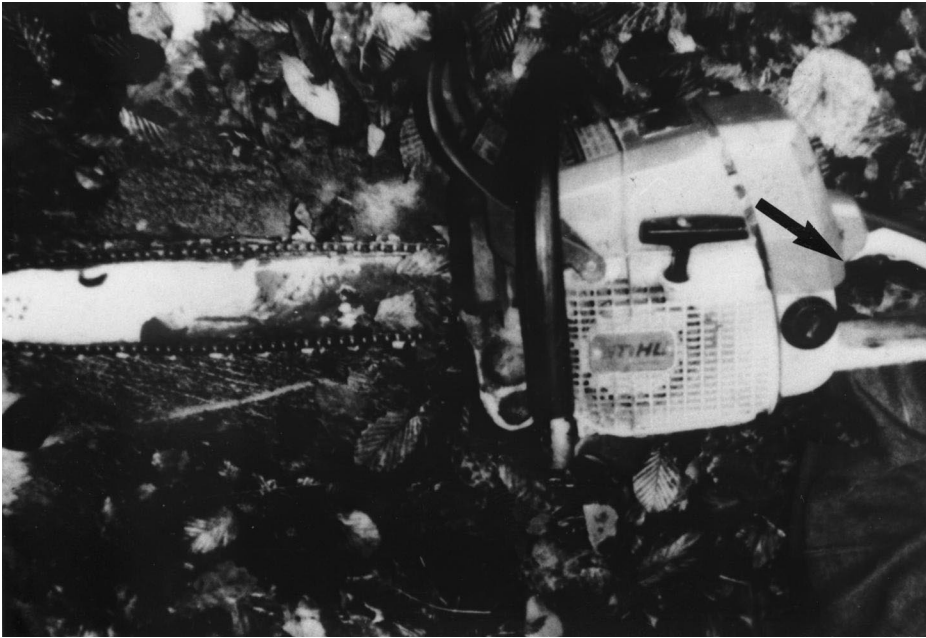


Fig. 3. Chain-saw found at the site (STIHL 044) exhibiting blood adhesions and particles of dirt on lower part of the saw blade. (Arrow: safety trigger at the underside of the handle bar.)

brake, automatic chain lubrication, chain revolutions in idling 2500/min, admissible maximum number of revolutions 13 500/min. According to the operating manual, the engine can be started in two different ways:

1. While the saw is on the ground, the operator steps with the right foot into the rear handle, places the left hand on the handle bar, and presses the housing of the saw firmly to the ground (see Fig. 4).
2. Alternatively, the motor can be cranked by squeezing the rear handle tightly between the thighs and holding the device in a horizontal position with the left hand behind the chain brake (see Fig. 5).

In either case, the clutch before the housing must be pushed forward to block the chain. The chain is unblocked by pulling it once again towards the housing. The chain can also be blocked automatically. If a sufficiently strong translatory and/or rotatory motion emerges, a mechanism of inertia will be actuated, e.g. in the course of a so-called “kickback” motion (see below).

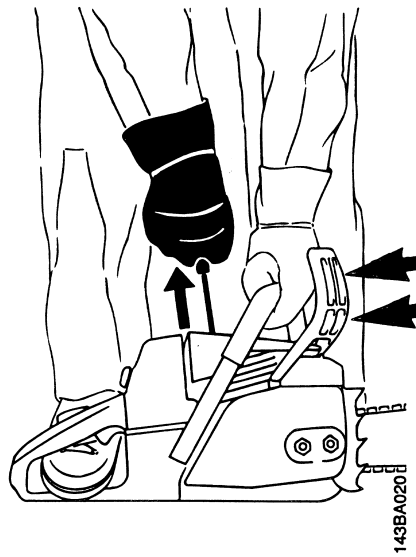


Fig. 4. Method of cranking the engine of the chain saw as recommended in the user's manual with the housing of the saw pressed firmly to the ground and the chain brake (double arrow) simultaneously pulled downwards to hold back the chain from running (reproduced with permission of Andreas STIHL AG and Co., D-71307 Waiblingen).

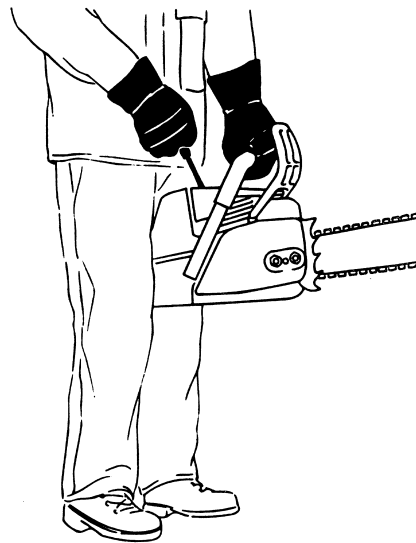


Fig. 5. Alternative method for starting the saw by squeezing its rear handle between the thighs in a horizontal position. The left hand is positioned at the forward handle engaging the chain brake (with permission of Andreas STIHL AG and Co., D-71307 Waiblingen).

2.3. Police investigations

The situation on the site where the corpse was found and the testimony of the witness suggested an accident to the police officers concerned. Three versions of the possible sequence of events, ranked in order of decreasing probability, were discussed:

2.3.1. Version 1

Having started the saw by pulling the starting rope, the victim slipped on the wet leaves, and the chain was running free at that time. The sword-like guide rail swerved around, and the chain entered the nape of the neck.

2.3.2. Version 2

The saw was situated on the victim's shoulder, with its engine running, and the chain began moving at the moment he slipped. It was therefore thought conceivable that the victim fell onto the saw, which had come to rest between the ground and his neck. Under both of these circumstances the injuries could have been caused while the victim was in an upright and/or recumbent position.

2.3.3. Version 3

The saw was on the ground and started off automatically for unknown reasons. The victim fell backwards onto the running chain.

The position of the saw on the left side above the body was explained by “reflex-like” movements of the victim, during which the right side of the housing must have hit the ground, because it was only there that adhesions of leaves and soil were visible. Whether there had been any mechanical manipulations being made at the chain saw itself remains still in question because the instrument could not be made available for inspection, let alone for scientific purposes, after the police had completed their duties.

2.4. Autopsy findings

Forensic medical autopsy was performed 4 days after death. Most importantly a deep, gaping wound measuring up to 3 cm in width was encountered on the back of the occipital region and neck (Fig. 6), whose edges were irregular and partly torn and where an oily liquid adhered to. It extended into the right cheek. The right wound angle was double-notched, the left one pointed. Another gaping wound measuring 6.5 cm in length and up to 2.5 cm in width was found in the lower nuchal region on the right in the transition to the shoulder (arrows in Fig. 6), running upward to the right from the midline. The tissue there was severed to a depth of about 1.5 cm. Above the wound first described there was another one with the dimension of 8 cm in length and about 1 cm in width (Fig. 7), with predominantly smooth rims. The upper wound edge encompassed a notch-like ledge, and two superficial and very thin wounds were uncovered parallel to the lower edge of the latter. Two notch-like wounds, one of them with a small detached flap of skin, were present on the right earlobe. Material from leaves or soil was not recognizable with the naked eye or by using a stereo microscope in any wound.

No other injuries, in particular such of the extremities, were disclosed.



Fig. 6. Deep lacerated wound in the nuchal region up to 3 cm wide and second irregular wound at the junction of the nape of the neck to the right side of the thorax (arrows).

After removal of the affected soft tissues from the skull base and the cervical vertebral column, several transverse fissures and notches corresponding to the deep large wound were detectable at the base of the occipital bone (see Fig. 8). The medullary canal of the upper cervical vertebrae was open, the spinal cord exposed, both atlanto-occipital joints were destroyed, the ramus of the right mandible (Fig. 9) exhibited saw-cuts, the right vertebral artery was lacerated at a location adjacent to the skull base. The brain was intact, except for a small collection of blood in the fourth ventricle.

Surprisingly, there was a 2.2 cm long step formation in the tabula externa below the 8 cm long scalp wound, suggesting that the bone had been tangentially sheared from above to below. This step stood out from the rest of the bone level for about 1 mm.

A blood alcohol concentration of 0.04‰ was analyzed, no psychoactive substances were detected in urine, blood, liver and renal tissue.

2.5. Interpretation of the findings

2.5.1. The forensic pathologist's point of view

In the preliminary autopsy report, death was interpreted as the sequel of a deep soft tissue wound in the nuchal region with subsequent hemorrhage from the lacerated right vertebral artery. The fissures in the occipital bone suggested repeated forceful application of the chain saw in the direction of the spinal column. In contrast, the pre-



Fig. 7. Occipital region with the major wound extending into the ramus mandibulae and the relatively sharp-edged wound suspicious of application of a chopping device (2 arrows). Single arrow marks a tissue defect in the right auricle.

dominantly smooth-edged wound situated further up and the step formation in the tabula externa there raised the suspicion that a chopping device, e.g. an axe, had been involved. It was assumed that the victim had at first been struck down with such a device and subsequently suffered the lethal chain saw injury. This assumption was supported by the absence of blood traces or tissue spatters on the victim's hands and clothes. Such spatters would necessarily have to be expected from a longer lasting action of the chain saw whose rear handle was gripped. Upon release of the throttle lever, however, the saw would have come to a standstill and could not have penetrated deeply several times.

To reconstruct the mechanism of damage in the present case a sawing experiment with a chain saw (engine power 1.2 kW) in the nuchal region of a dead dog, a male boxer weighing 33 kg, was performed. The wound morphology (see Fig. 10) was similar to that described earlier. A time of 2 to 3 seconds was required to saw through the nape of the neck to the bone. Moreover, tissue adhesions on the casing of the engine (Fig. 11) could be documented, as would be expected upon application of the lower part of the guide rail to the victim.

2.6. *The view of the police*

The autopsy results led to a renewed investigation effort by the police and a detailed inspection of the site of the lethal event. There the trail of slippage on the chipwood



Fig. 8. Occipital bone with multiple fissures in the right nuchal plane attributed to repeated action of the chain saw (arrow at the external occipital protuberance).

board mentioned earlier ended in mud, in which a shoe print of the victim had already been ascertained. These criminalistic findings confirmed the initially postulated sequence of events, namely that the 8 cm long injury in the upper part of the nape of the neck, which corresponded in size to the rocky ledge, might have been caused by that. The absence of dirt on the frontal part of the clothes and of defense injuries spoke against a preceding fight. Had the victim been struck down with an axe, he would have fallen forward or sideways and would have come into contact with wet leaves or the ground. Further injuries and soiling would have been unavoidable if the saw had been applied to someone who was impaired in his ability to act. The saw would most likely have been applied while the victim was lying prone or on the side, so that traces of blood running towards his face or chest would have to be expected.

3. Discussion

Engine-powered chain saws have been used in forestry in Germany for about 70 years [20], and nowadays they have become a wide-spread tool for “do-it-yourselfers” with about 22 million estimated having been available in American households alone for the year 1986 [9]. Nonetheless, it was not until 1984 that they have been dealt with for the first time in forensic medical literature. Up to then there had been only clinical reports about accidental injuries [7,10,15,16,18,19,21,22,24,25,29,30] and such referring to chronic damage resulting from vibration or engine exhaust in an industrial setting



Fig. 9. Right ramus mandibulae with an osseous laceration in the posterior portion caused by the chain saw (double arrow, single arrow: processus condylaris mandibulae).

[11,23]. In 1984 Bonte et al. [5] evaluated 719 events that had been reported to social casualty insurance associations (Berufsgenossenschaften) and private insurance companies in Germany. Special attention was paid by these authors as well as by Sigrist [28] to possibly self-inflicted injuries. Schiwy-Bochat [26] and Segerberg-Kontinen [27] each reported a case of suicide. To our knowledge, homicide by means of a chain saw has not previously been made known.

The present case elucidates differences between the police officers and forensic pathologists in assessment of the sequence of events being in question. From the *medical point of view* there can be no doubt that the lethal injuries were attributable to a chain

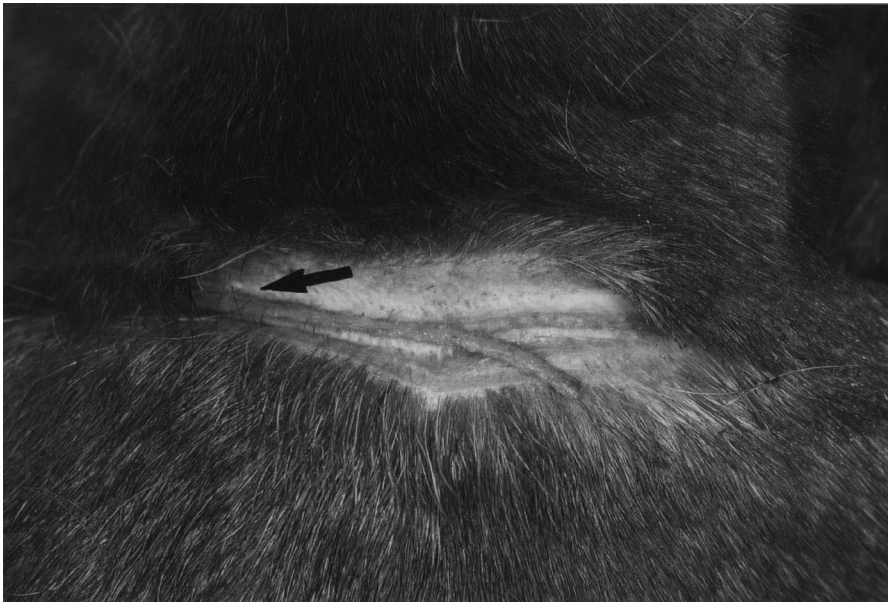


Fig. 10. Nuchal region of a dead dog after experimental application of the lower part of a chain saw for 2–3 seconds exhibiting the resulting wound with parallel rims and a sharply delineated skin flap originating in the wound angle (arrow) where the chain firstly touched the tissue.

saw. As Bonte pointed out [5], such an injury is morphologically so characteristic that it can be clearly differentiated from such caused by other machinery. It consists of parallel skin wounds with gross, deep bruising of the underlying tissue and formation of pointed skin flaps in the region of the “entrance” wound angle [26], i.e. the point where the chain was applied with the possibility of directing its course. The so-called “chipper-tooth chain” commonly in use today is a chain type, in which the distance between the teeth is approx. 3 cm [26]. The teeth are 90° offset towards the middle of the chain and have two perpendicular cutting surfaces. Due to this construction, the tissue is cut as well as bruised and at the same time considerably contaminated with foreign material. Macfarlane [17] has stated that “the chain saw both cuts and chews its way through tissue”. Experimenting with corpses, Schiwy-Bochat [26] was able to show that the saw slips off the skin under slight pressure and creates only superficial injuries thereby. Accordingly, a stronger pressure on the blade is necessary to make the saw enter the skin and the soft tissue beneath.

Based on experiments of his own, Bonte [5] has postulated that amputation of a finger, for instance, takes 4–6 seconds if the saw is operated with one hand. The manufacturer of the chain saw here in question states that it has a cutting capacity of approx. 100 cm² to 150 cm² for beechwood [20]. This means it would take about 1 second to saw through a round timber measuring 5.5 cm to 7 cm in diameter. Accordingly, the time quoted [5] for sawing through a finger bone seems too long. Whether contact with bone leads to a considerable slow-down of the chain, as assumed

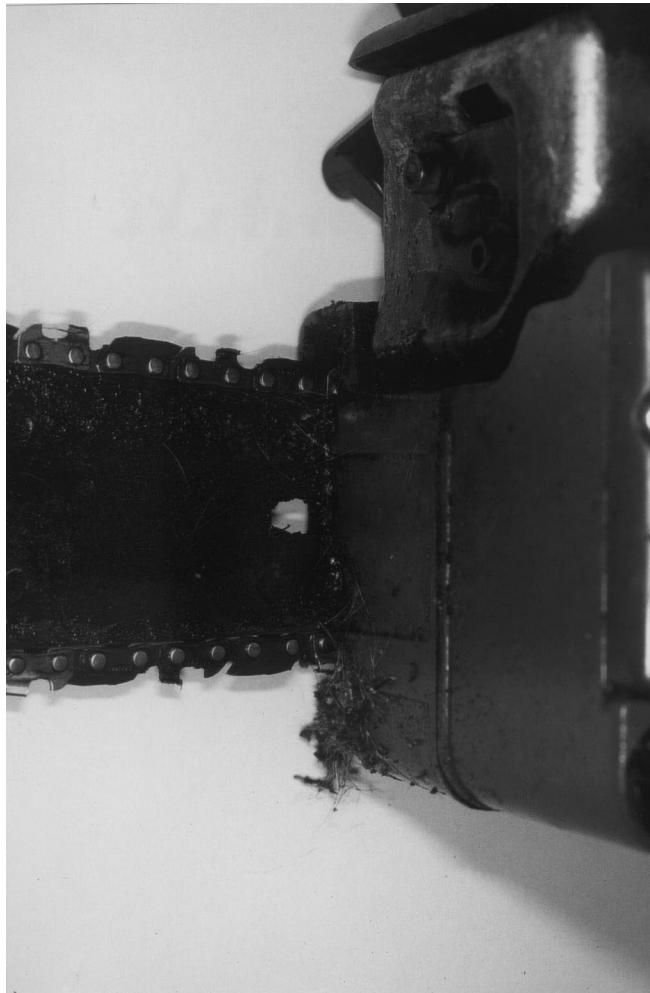


Fig. 11. Housing of the engine used in the experiment. Note adhering blood and tissue from the skin of the dog including hairs.

by Haynes [12], is doubted by Schiwy-Bochat [26]. It is a fact, however, that substantial kinetic energy is a prerequisite for producing bone injuries, but quantitative measurements of the needed forces are still not available.

A well-known accident mechanism in the operation of chain saws is that the running saw hits the head or trunk of the operator as the result of a so-called “kickback” motion [7,12,16]. In such, the saw is suddenly and uncontrollably hurled towards the operator with a velocity of up to 33 miles per hour [22] if, for example, the chain at the upper quarter of the bar tip unintentionally engages wood, rock or another solid object, if the chain briefly jams in the process of cutting, or if another branch is accidentally hit when

trees are freed from limbs. Modern chain saws are equipped with a number of safety devices [21,22] to prevent accidents as far as possible.

3.1. Forensic medical evaluation of the case

Applying the literature knowledge to the actual case the presumption is corroborated that the saw was repeatedly put onto the neck with substantial force. This follows already from the findings at the skull base, the opening of the first cervical vertebra and the medullary canal, the cut marks in the right ramus mandibulae as well as the presence of a second lacerated wound below the main one.

The *first version* of the police supposed the chain saw as having “flung upward”. Had this happened, traces would have to be expected on the upper side of the bar, but they were in fact present on the underside instead.

In principle, the chain of all modern motor saws can only be set in motion by continued pressure on the safety trigger [20] after previous operation of an independent blocker and release of the chain brake.

Had the victim improperly been carrying the saw on his shoulder while the engine was running (*second version* of the police), and had the chain started moving through a sudden pressure on the trigger at the moment he slipped, it is not conceivable that the pressure would have constantly been maintained over a period of probably several seconds.

It can definitely be ruled out that the man fell into the moving chain while the saw rested on the ground (*third version* of the police), because the chain does not keep running automatically, and because blood traces on the upper side of the blade would have been obligatory then. Moreover, material from the ground, e.g. bits of earth or sand, would have been adherent.

Experiments with a dead dog (see above) have shown that the chain pulls only slightly forward when the head rests passively on the chain rail and then jams.

Inadvertent activation of the engine trigger, for example through pressure of a part of the body lying above it, is not realistic due to the situation of the trigger underneath the handle (arrow in Fig. 3).

Equally incompatible with an accident is the shape of the transverse and predominantly sharp-edged wound with step formation and tangential nicking in the bone cranial to the main laceration. According to Kratter [14], these features are characteristic for injuries inflicted by a chopping or hewing tool. When hitting the bone, the tool may come off and cause secondary accidental defects of similar nature in the immediate vicinity of the primary wound [3]. This might explain numerous small smooth-edged parallel wounds above the deep one. Causation of these smaller injuries by falling with the back of the head on a sharp-edged stone is not consistent with the wound morphology, especially not with the course of the notching in the bone. Had such a fall happened, an impression would most probably have resulted from the nearly vertical collision with the edge of the rock. A comparison of the traces with a presumably responsible device [4] was impossible because no such chopping tool could be found.

Under medico-legal aspects much evidence spoke for the presumption that this may well have been a case of homicide. Given that scenario the victim was first struck down

with a chopping device, and the chain saw was subsequently applied several times. The almost complete lack of blood trickles on the frontal aspect of the corpse and the intact clothing is a most remarkable phenomenon.

The possibility of a suicide as in Schiwy-Bochat's case [26] seems to warrant some attention, although very unlikely in the view of the authors. No psychiatric abnormalities were reported by the victim's employer. It appears at least difficult for a single person to cause such extensive lacerations as seen here, not to speak of the bony defects, but may not be absolutely ruled out.

Nonetheless, a further legal investigation by the public prosecution authorities has not been implemented so far.

This case report emphasizes the necessity of integrating the forensic pathologist from the beginning into the police investigation of the scene, which did not take place here. The presence of a medico-legal expert experienced in the assessment of wounds can prevent premature commitment to a hypothesis which is merely supported by the situation encountered at the scene.

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