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Case report

Possible XOR fallacy – Case report of combined foramen sternale with an osseous sternal knife stab injury

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ABSTRACT

This case report details a sternal finding that first was reported as penetrating knife stab wound. It was one in a series of 24 otherwise relatively superficial skin stab wounds allegedly performed by a single assailant within the scope of a single attack. The effort required to penetrate the sternum with a knife appears to be considerably higher than to inflict relatively superficial skin and soft tissue penetration. This initially raised suspicion of another person contributing to the attack, or, a different weapon being used. After reviewing the clinical CT scans, we identified the combination of a preexisting sternal foramen with a marginal fracture and concluded that the sternal "penetration" was in keeping with the depth of the other 23 stab wounds. None of the injuries were lethal, the victim survived the attack. Assuming that a knife penetration fracture of a sternum and a foramen sternale are mutually exclusive constitutes an exclusive-OR fallacy (XOR fallacy).

1. Introduction

Forensic pathology on occasion presents the medical doctor with potential fallacies. One well known interesting fallacy is the specificity paradox [1]: just because a finding is particularly impressive, it may still not be a sufficient representation of what all is forensically relevant in any given case.

As one example, intracerebral hemorrhages are typically attributed to natural disease. Their morphological appearance can be large and visually impressive. However, they may be associated with drug use [2,3] whereas normally developed or aneurysmatic vessels rupture after cocaine or amphetamine consumption, and so such a death may not be natural. So on top of a visually impressive intracerebral hemorrhage being presented (for example, by post mortem scanning), a more comprehensive examination with autopsy, histology and a toxicological analysis may have to be performed before a forensically correct cause and manner of death can be attributed. The assumption that *either* a natural disease caused intracerebral hemorrage *or* that a fatal intoxication is *the* cause of death will constitute a medicolegal fallacy in this context: it naively assumes that somehow, a cerebral hemorrhage prevents a toxicological cause of death from being present while in reality there may be overlaps. A generalization of this particular fallacy would describe such a seemingly conflicting constellation as an "exclusive or" (XOR) fallacy, or as so-called false dilemma, which has been stated to be a particularly insidious fallacy [4].

This case report features a sternal foramen that, in addition, was stabbed; a hole in a hole, where the sternal foramen presented a predilection of sorts. This rare combination of relatively rare findings obviously was not obvious at first. The first radiologist to examine this case identified bone fragments and concluded there to be (just) a perforating sternal knife stab injury. Consequentially, he had not considered any other morphology. Ironically, this assessment follows literature rather strictly: a sternal defect is typically presented as *either* anatomical *or* traumatic [5–7] without explicit awareness for the width of the implicated norm [8].

In reality, co-occurrences of only apparent opposites are almost typical paradoxes in forensic medicine that are reported again and again without reference to the underlying assumptions or norm. They end up being tied into the "XOR fallacy": injury survivors may get injured in criminally relevant activities by others and later present in combination with self-inflicted injuries [9]; victims of bodily injury may enhance findings using make-up [10].

2. Methods and materials

2.1. Case description

In this instance, 24 sharp force injuries were inflicted on an adult male by a clearly drugged male assailant. The victim, at first, was reported to have been lying on his bed asleep; after being stabbed, he suffered blood loss, particularly from arm and leg injuries. He was admitted to hospital with lower than normal blood pressure consistent

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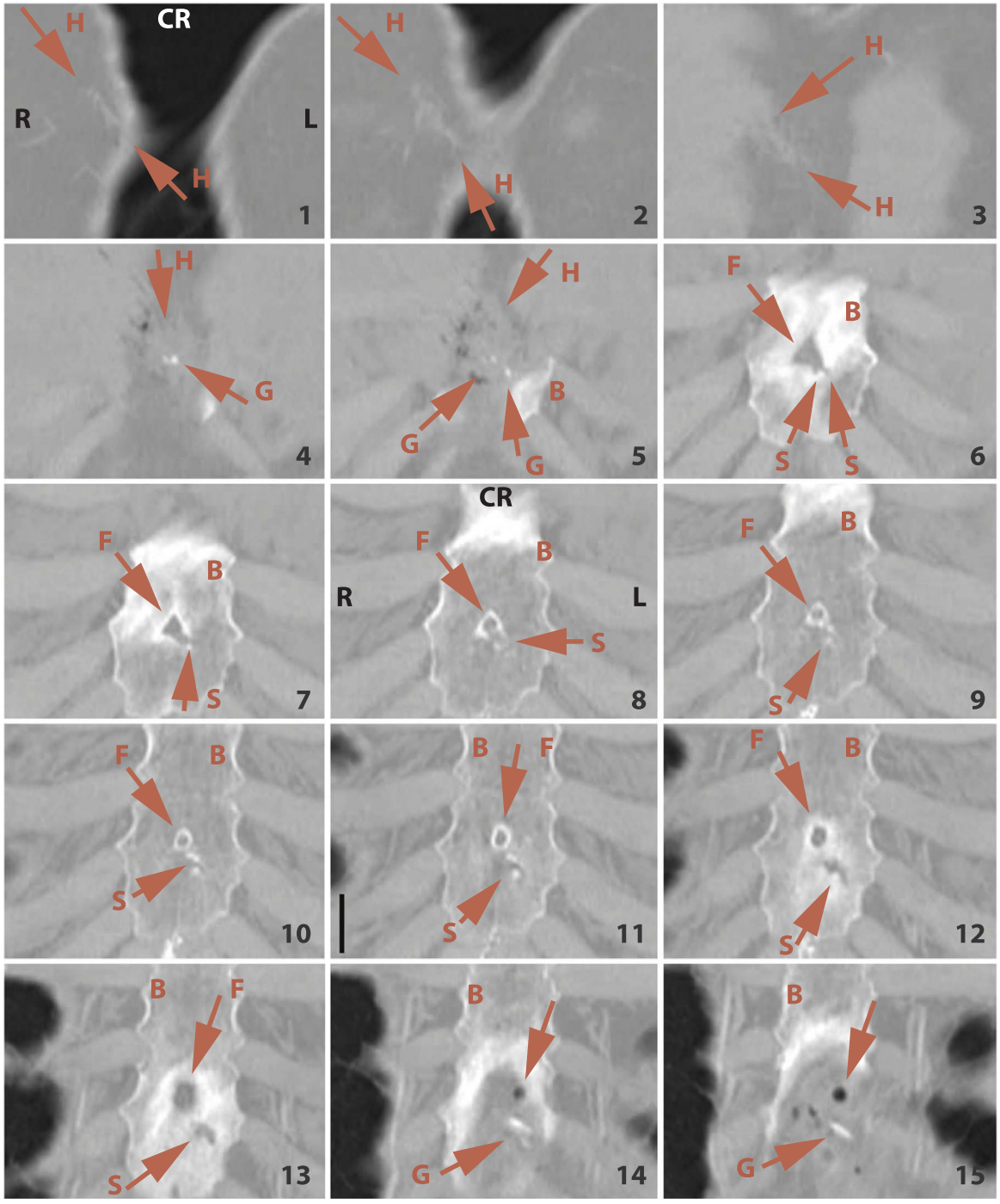

Fig. 1. Underneath a right sided chest skin stab wound with features matching a single-edged knife, there is a subcutaneous chest hematoma (H) approaching the sternal bone (B) from the right side. The sternum then features a roundish corticalized defect termed sternal foramen (F). Caudoventrally located within the inner lower anterior rim of that foramen, there is a sharp force bone injury (S) accompanied by bony fragments (G). Coronally sliced MPR stacked front (1) through back (15). Orientation/scale: CR cranial, R right, L left, bar 2 cm.

with beginning hemorrhagic shock. He survived with medical and surgical treatment. None of the stab wounds were deeper than around 2–3 cm, with the possible exception of one: the clinical radiologist diagnosed a penetrating sternal stab injury underneath a chest skin wound that contained straight edges and wound angle features consistent with a single edged knife. There were no indications that suggested or were typical for self infliction .

The forensic question here was that of whether the depth of all stabs presented congruence, as they were mostly relatively shallow. The assailant had reportedly stated, that he had been under the influence of drugs, and repeatedly stabbed the victim, but not with extreme force. To penetrate the body of the sternal bone, however, would be an apparent contradiction there. With that, the constellation of all stab wounds had raised the question whether the sternal injury was performed with far more force than the remainder of these multiple injuries. From there, the investigators of this case then would have had to possibly consider also the option of a second assailant being involved (Fig. 2).

2.2. PMCT scanning and data presentation

Clinical computed tomography (CT) scans had been performed on a