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ORIGINAL ARTICLE

Single stab injuries

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Abstract
Determining the manner of death in cases involving multiple stab injuries from a knife is generally straightforward. The medico-legal investigation of a stabbing death caused by a single stab injury from a knife comprises a smaller but potentially more problematic subset of forensic cases. We reviewed our institute's experience with single stab injuries and endeavored to identify features identified at the post-mortem examination which may aid in the differentiation between cases of homicide, suicide and accidental death. The single stab injury was to the left chest in the majority of deaths from homicide and from suicide. Clothing was nearly always involved in cases of homicide, but was also seen in cases of suicide. The knife was found in situ in 9 of the 11 cases of suicide involving a chest injury, but was not seen in any of the cases of homicide. There were no cases of an accidental single stab death from a knife in our records. Clinical data on accidental stab injuries was sought via a search of the medical records of a major tertiary referral hospital. A single non-fatal case of an accidental single stab injury from a knife was identified after the conclusion of our study period. Accidental stab injuries from a knife causing injury or death are rare.

Keywords Sharp force injury · Single stab · Homicide · Suicide · Running onto a knife

Introduction

In the majority of cases involving stab injuries, the manner of death, whether it be homicide, suicide or accident, will be accurately determined by a thorough examination of the scene of death by a crime scene examiner, a careful evaluation of the known circumstances of the death, a review of the medical and/or psychiatric history of the deceased by a forensic medical expert, and a detailed post-mortem examination.

The findings at the scene of death can be crucial in determining the manner of death. In cases of suicide, the deceased may leave a suicide note and/or have photographs or other personal items on view [1]. The weapon in question should be present at the scene and is a highly important scene finding. The pattern and distribution of blood stains may allow a blood spatter analysis expert to reconstruct the probable events surrounding the death [2].

If the victim was clothed at the time of the incident causing death, and the sharp force injury is to non-exposed skin, it has been suggested that associated damage to clothing is seen in cases of assault, whereas in cases of suicide by self-stabbing, there is a tendency for the deceased to move clothing aside prior to infliction of the injury [3, 4].

Accidental sharp force injuries are distinctly uncommon. The majority of accidental sharp force injuries causing death result from falling into panes of glass [5]. In the absence of other significant injuries it may be suggested that a single stab injury (SSI) had resulted from the deceased accidentally 'running onto the knife' [6].

Prior studies have reviewed their jurisdiction's experience with deaths from all stab and sharp force injuries and a review paper suggested a brief checklist for the reporting of these cases [7–9].

There are a number of case reports and short series in the English speaking forensic literature describing specific examples of death from a SSI [10–12]. To the best of our knowledge there is no published retrospective study in the English speaking literature specifically addressing deaths caused by a SSI.

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Deaths associated with a single stab injury (SSI) can be a challenging problem for investigating police, forensic pathologists, and the courts to resolve. In some cases the manner of the death in a case of SSI may prove impossible to establish. We sought to determine whether there are differentiating features between homicide, suicide, and accidental SSI deaths which can be gleaned from the post mortem examination. To further our experience with accidental single stab injuries, we liaised with one of Melbourne's major trauma centers to investigate the circumstances of non-fatal sharp force injuries from knives.

Methods

The analysis of cases in this study was limited to SSIs. A stab injury was defined in this study as a sharp force injury that is deeper than it is wide. Although many varied sharp objects, such as shards of glass, screw drivers, scissors, and sharpened metal rods or shivs, can all cause a stab injury, this study was limited to incidents where the weapon causing the SSI was a knife.

A SSI was defined as a solitary stab injury and was seen in the absence of any other significant injuries. In particular, decedents who had incised injuries to the upper and/or lower limbs which may reasonably be interpreted as a 'defensive injury', or additional superficial sharp force wounds around the SSI which may be reasonably interpreted as 'hesitation injuries' were excluded from further analysis.

Decedents which showed minor injuries in a single plane consistent with an uncomplicated fall, as may occur following an episode of collapse from a standing height, were included in the study. Decedents with other injuries such as lacerations and bruises from blunt force trauma, and those with gunshot injuries, were excluded from the study.

The digital autopsy reports from the Victorian Institute of Forensic Medicine (VIFM) were searched from 1st January 1991 to the 31st December 2014. The search criteria consisted of the word "stab" in the cause of death field in the institute's case management system (iCMS). Autopsy reports found in the search were then manually reviewed to identify cases of SSI. Cases which did not meet the definition of a SSI were excluded from further study.

The decedents were separated into cases of homicide, suicide, or accident according to the forensic pathologist's final designation of the manner of death in iCMS. If the death was not classified, one of the authors (MPB) reviewed the available documents and assigned the case with the manner of death.

For the cases of homicide; the age and sex, the site of the stab injury, whether clothing was involved in the stab injury, and the results of the toxicology analysis, were collated in Table 1.

For clothing to be considered to have been involved in the incident, a slit-like defect to the clothing was seen in a close regional relationship to the SSI suffered by the deceased.

For the cases of suicide; the decedents age and sex, the site of the stab injury, whether the clothing was involved in the stab injury, whether a suicide note was present at the scene of death, whether there was a history of depression and/or mental illness or the presence of anti-psychotic or anti-depressant medications identified in the toxicology analysis, the tissues involved by the stab injury, and the results of the toxicology analysis, were extracted and collated in Table 2.

Cases of non-lethal SSI from a knife were sought from The Alfred Hospital, a major trauma referral hospital in Melbourne, Victoria, Australia. The key words 'stab', 'run onto knife', and 'accidental stab' were used to search the data from The Alfred Hospital's records. The study period was from 1st July 2001 up to and including 26th July 2014. The case summaries were reviewed by one of the authors (MPB). In cases where the manner of the injury sustained was unclear, the medical record was manually reviewed by two of the authors (MPB and ZC) and a consensus reached as to the manner of the injury's infliction.

Research and ethics approval was sought and obtained from the Victorian Institute of Forensic Medicine and The Alfred Hospital.

Results

Results from the files of the Victorian Institute of Forensic Medicine

Homicide

There were 56 cases of SSI classified as homicide. Of these there were 48 males and 8 females. The male victims ranged in age from 18 to 72 years with a mean age of 37 years and median age of 33 years. The females ranged in age from 18 years to 56 years with a mean of 37 years and a median age of 41 years.

There were 45 cases where the site of the injury was to the chest (82% of cases). The abdomen was involved in eight cases and the neck in 3.

Of the 45 cases with a SSI to the chest, 36 involved the left side of the chest, and 9 involved the right side of the chest. The SSIs to the left chest ranged from 3 cm to 30 cm to the left of the midline, with a mean of 10 cm and a median of 8 cm. The SSIs to the right side of the chest ranged from 1 cm to 25 cm to the right of the midline, with a mean and median of 7.5 cm.

In 33 cases, the clothing was available for examination at the post mortem examination. In the remaining cases, either clothing was not worn at the time of the incident or had been removed during treatment by para-medical or medical personnel. In three cases the SSI involved the neck. In the cases involving the chest or abdomen, a defect in the clothing associated with the SSI was seen in 28 cases (93%).

Table 1 Homicide cases

Demographics	
Number of cases (M:F)	48:8
Age – male (mean, median)	18 to 72 (37,33)
Age – female (mean, median)	18 to 56 (37, 41)
Site of injury	
Left Chest (N; dist from midline, mean + median)	36, 3 to 30 cm, 10, 8 cm
Right Chest (N; dist from midline, mean + median)	9, 1 to 25 cm, 7.5, 7.5 cm
Abdomen (N)	8
Neck (N)	3
Involvement of clothing	
Available for examination	33 cases
Defect associated with clothing	28 (93%)
Toxicology	
Alcohol N (range, mean + median)	27 (0.2 to 0.3 g/100 ml; 0.13 and 0.13 g/100 ml)
Amphetamines (N)	8
Antidepressant/antipsychotics	3

Alcohol was detected in the blood of victims of a SSI in cases 27 of the homicide cases. In one case the alcohol level was not available. In the 26 cases where alcohol was detected in the blood of victims, and a result was available, the alcohol level ranged from 0.02 g/100 mL to 0.30 g/100 mL with a mean and median of 0.13 g/100 mL. Amphetamines were present in the blood of eight cases and antidepressants or anti-psychotics were present in three cases.

Suicide

There were 15 cases of SSI classified as suicide. Of these cases there were 11 males and 4 females. The males ranged in age from 23 years to 74 years with a mean of 48.8 years and a median of 45 years. The females ranged in age from 17 years to 69 years with a mean of 48 years and a median age of 53 years.

There were 11 cases where the SSI involved the chest (73% of cases). All of these involved the left chest. There were four SSIs to the abdomen.

The SSIs to the left chest ranged from 2 cm to 11 cm to the left of the midline, with a mean of 4.7 cm and a median of 4 cm to the left of the midline.

In the nine cases where clothing was worn and was available for examination at the autopsy, five cases showed a stab type defect associated with the SSI.

Alcohol was detected in the blood of three decedents. There was 0.04 g/100 mL in the vitreous humor of one decedent, whilst two others had blood alcohol concentrations of 0.10 and 0.30 g/100 mL respectively.

Table 2 Cases of suicide

Demographics	
Number of cases (M:F)	11:4
Age – male (mean, median)	23 to 74 (48.8 + 45)
Age – female (mean, median)	17 to 69 (48 + 52)
Site of injury	
Left chest (N; dist from midline, mean + median)	11, 2 to 11 cm, 4.7, 4 cm
Abdomen (N)	4
Knife in situ	
Left Chest	9 cases (81% cases involving chest)
Involvement of clothing	
Eleven cases with clothing available for examination	5 with associated stab defect
Toxicology	
Alcohol (N, range)	3 (.04 to. 30 g/100 mL)
Amphetamines (N)	0
Antidepressant/antipsychotics	5

One case (case 5) classified as suicide had no suicide note nor other objective evidence of prior depression or mental illness. There were four cases where a suicide note was identified and a further case where personal notes were said to reflect a 'depressed state'. In all other cases, there was either a clinical diagnosis of depression or schizophrenia, and/or the presence of an antidepressant and/or antipsychotic medications identified in the toxicology analysis.

A noticeable feature of the cases classified as suicide was the presence of the knife in situ within the chest in nine decedents.

Accident

There were no cases of an accidental SSI from a knife was recovered from our files.

Results from the files of the Alfred Hospital, Melbourne, Victoria.

Twenty nine of the 1136 cases retrieved from The Alfred database necessitated manual review of the patient's medical record. No instances of 'running onto a knife' or 'accidental stab with a knife' was documented in any of the cases.

Postscript

Following completion of the study a clinical case came to the attention of one of the authors (ZC).

The ambulance records in the patient's medical record stated;

> *" Pt was at a house party when he was allegedly stabbed (accidently) when he walked into a knife being held by friend. Knife had approx. 6-7cm serrated blade and appeared to be covered in blood to hilt…… consumed approx. 250-300ml of bourbon and smoked joint prior to incident".*

The injury was non-lethal.

Discussion

Stabbing is not uncommon in cases of homicide but as a mode of suicide is generally considered to be uncommon. An examination of suicide by stabbing in the city of Tokyo over a twenty year period showed fluctuating absolute annual numbers but a proportion of suicide cases between 2.3 and 4.7% [13]. In the western suburbs of Paris between 1994 and 2001 there were 511 cases of homicide, of which stab injuries were the cause of death in 27%; compared to gunshot wounds in 37%, blunt force trauma in 19%, and asphyxia in 13% of cases [14]. In Australia in 2013 there were 249 victims of homicide. Stab injuries were responsible for the deaths of 83 victims (43%) [15].

Factors such as unemployment, recent retirement, and family history of suicide have been shown to be associated with an increased risk of suicide [16]. Individuals with a psychiatric history are more likely to commit suicide by stabbing than those without a diagnosed mental illness [17, 18]. However it should be noted that those with psychiatric disorders such as schizophrenia are also at an increased risk of homicide [19].

Single stab injuries are not infrequent in medico-legal death investigation. A SSI was the cause of death in 9.8% of 92 victims of homicide by sharp force injury in a study from Italy [20]. In our 71 cases of death from a SSI there were 56 (79%) cases classified as homicide and 15 (21%) attributed to suicide. There were no cases classified as accidental.

In our cases of suicide from a SSI associated damage to clothing was documented in five of the nine cases (56%) when clothing was worn and available for examination. In two of the 30 cases classified as homicide where the clothing was presented for examination and the injury was to the chest or the abdomen, there was no defect found in the clothing. The absence of an associated defect to clothing may reflect movement of the clothing during the incident which led to death.

Although the numbers of suicide in our study are small, with only 15 cases attributed to self-inflicted SSI, it was notable that there was only one case (6.7%) where there was either no suicide note or any other historical or toxicological evidence to indicate a mental illness. In nine of our eleven cases of suicide involving an injury to the chest (82%), the knife was in situ within the deceased's body when the body was discovered.

We found the site of the SSI was similar in both homicide and suicide cases. In 82% of our cases of homicide the SSI was to the chest, with 37 injuries to the left side of the chest and 9 to the right side. In our cases of suicide by SSI, 11 of the 15 cases (73%) were to the chest, and all to the left side. This may reflect basic anatomical knowledge in the community, though one may suggest the prevalence of left sided chest injuries in cases of homicide could be contributed to by the predominance of right handedness in the community [21]. It may also reflect the situation where an injury to the lung parenchyma is less likely to be lethal than an injury involving the heart and/or great vessels.

The presence of alcohol in the blood of the deceased was more common in the cases of homicide, with alcohol detected in just under half of the deaths. These cases had a mean alcohol concentration of 0.13 g/100 mL. In comparison only three of the fifteen self-inflicted deaths were intoxicated with alcohol.

Accidental sharp force injuries are very common in the community. A study from the United States of America (USA) examining knife related injuries to children and adults revealed that over one thousand knife-related injuries were treated every day in emergency departments [22]. Sharp force injury accounted for 0.29% of all accidental deaths in a study from Dallas, USA, between 1990 and 1999 [23]. Of these 20 cases of sharp

force injury, there were 11 'stab' wounds, none of which involved a knife.

We did not have a case of death from accidental SSI from a knife in our case files.

Although accidental stabbing deaths are rare, the possibility of a person accidentally running or moving onto a knife is described in the forensic literature [6]. The blade's inertia, if the tip of the blade is very sharp, is said to be sufficient to allow the blade to pass through soft tissues after the skin has been breached.

Whilst the genesis of such an injury has a sound theoretical basis, our review of the English speaking forensic literature failed to find a case of documented accidental SSI from 'running onto a knife' causing death. A case report in the German literature does describe an incident where a 14 year old boy suffered a fatal accidental SSI inflicted by his mother [24]. She had just removed a knife from the dishwasher, held it up with the sharp blade pointing outwards, and turned to put it into a glass situated at the entrance to the kitchen just as her son ran into the kitchen. He was described to have 'literally jumped' as he moved into the kitchen resulting in his mother inflicting a SSI to the left chest. The stab wound involved the boy's heart. As suggested by Mueller, 'fixation' of the knife appeared to be of 'decisive significance' [25]. The authors concluded that the claim of 'running onto a knife' *should not always* be regarded as dubious.

In our study the issue of accidental stab injuries was further explored by an examination of non-fatal injuries in patients who attended at the Accident and Emergency Department of a major metropolitan hospital in Melbourne, Victoria. During the twenty year period examined no cases of 'running onto a knife' were discovered. However, after the conclusion of the study period, a case of non-lethal SSI to the abdomen from 'running onto a knife' was detected. (See Results – Postscript).

Key points

1. In cases of homicide and suicide the SSI tends to involve the left chest.
2. Clothing is nearly always involved in cases of homicide, and may be involved in cases of suicide.
3. A knife found in-situ within the chest in a death from a SSI suggests suicide.
4. Accidental single stab injuries causing death or serious injury are very rare.

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