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Homicide or suicide? A probabilistic approach for the evaluation of the manner of death in sharp force fatalities

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Abstract

The role of forensic science can be defined as providing relevant opinions to assist investigators and courts of law in answering questions. The Likelihood Ratio (LR) provides a quantitative and logical approach to communicating the strength of expert evidence. We reviewed existing forensic literature on sharp force fatalities, focusing on studies reporting the manner of death and the frequency of some characteristics that are traditionally assessed. Four studies were included, resulting in a database of 173 suicides and 354 homicides. The LR of each of the characteristic under both hypotheses (suicide and homicide) was obtained. Subsequently, the LR was computed in six fatalities with known manner of death, three suicides and three homicides, by multiplying the corresponding LR of each individual characteristic. LR ranged from 115 to 140,250 in suicidal cases and from 9 to 2728 in homicidal cases. Compared to other fields of forensic science where LR is used extensively, the values obtained in our cases of sharp force fatalities is low. However, in forensic pathology there is evidence that is outside the expert's opinion, and it is for the trier of fact, such as the judge or jury, to draw conclusions. Nevertheless, the LR serves as a tool for interpreting and weighing evidence while maintaining the distinct roles of the trier of fact and the expert. To comprehensively apply the LR in the field of sharp force deaths, it will be necessary to standardize the methodology of investigation and data collection in descriptive studies.

KEYWORDS

autopsy, courtroom testimony, estimating uncertainty, forensic pathology, homicide, likelihood ratio, sharp force fatalities, suicide, weight of evidence

Highlights

- The Likelihood Ratio (LR) is a way to logically convey the strength of evidence.
- We calculated LR for characteristics repeatedly investigated in the literature of sharp force deaths
- The LR calculated in six real cases were consistent with the known manner of death.

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- Calculating the LR can be useful in distinguishing between suicide and homicide.
- LR can be used for weighing evidence, but further research to standardize data collection is needed.

1 | INTRODUCTION

The role of the forensic expert is to provide a relevant opinion to help answer questions to investigators and to courts of law [1, 2]. Even if Bayesian decision theory is not necessarily suited for presentation of evidence in court [3], many fields of forensic sciences have adopted this method of evidence interpretation, which provides an approach to logically convey the strength of the expert's evidence via the so-called Likelihood Ratio (LR). The essential challenge is whether and to what extent the expert's observations may be used to distinguish between two mutually exclusive hypotheses. These hypotheses, referred to as propositions, usually represent the positions of the prosecution and the defense [4]. Forensic pathology seems slow to adopt these principles [4], and few examples of application of the LR have been reported in forensic literature [5, 6], none of them in the field of sharp force fatalities.

During investigative proceedings of sharp force trauma, as well as at trial, the forensic expert can provide key elements for decision makers, enabling them to reach an opinion regarding the manner of death. In such context, a forensic pathologist can be asked to define if a sharp force fatality is the consequence of a suicide or of a homicide, as accidental sharp force fatalities are very rare and often have an unequivocal mode of death [7] based on the evidence observed during death/crime scene investigation, autopsy, toxicological examinations, and other ancillary investigations. Criteria for the differentiation of self-inflicted injuries from injuries inflicted by another person are described in classic and modern textbooks of forensic pathology, and include anatomical site, number of injuries, hesitation wounds, type and localization of the weapon, clothing analysis, psychiatric history, and scene/autopsy findings [8]. It is impossible for the forensic expert to quantitatively express these criteria and to provide the court with a number that expresses the strength of the evidence [9]. However, the collection of case series published in the forensic literature could ideally be used to determine whether and to what extent the evidence supports the hypothesis of homicide as opposed to suicide or vice versa, based on the frequency of observations in both circumstances [10, 11]. The probative value of the evidence, without having to consider the prior probability of the hypothesis, can be measured using the LR [12].

The aim of this study was to review the existing forensic literature on sharp-force deaths and to assess the frequency of characteristics related to the manner of death. The probative value of each of the characteristics assessed, expressed in terms of LR, was then reported and calculated for a series of sharp force deaths with known manner of death.

2 | MATERIALS AND METHODS

2.1 | Systematic review

A systematic review of the literature for cross-sectional studies involving sharp force fatalities was performed on PubMed (All fields) and Scopus (Article title/Abstract/Keywords). The search terms were “sharp force” and “fatalities,” and the research was kept intentionally broad to be as sensitive as possible. The research was performed on 19 October 2022 and a temporal restriction was applied to articles published after January 1986. In addition, bibliographies of published review articles as well as studies relevant to the research question were manually searched, and potentially eligible references were included in the full-text review. A comprehensive database of the retrieved articles was built and checked to remove duplicates. Only original English-language articles that clearly reported the manner of death and the frequency of relevant recurrent forensic features commonly described in the forensic literature were included. Studies with small sample sizes (<30 cases) or samples focused on a single mode of death (suicide only or homicide only) were excluded. The following characteristics were extracted from the database: gender of the victim, number of sharp force injuries and anatomical wound distribution, alcohol detection, history of psychiatric illness, damage to clothing, place where the body was found, and type and location of the sharp force object used. Studies reporting the frequency of two or more characteristics identified in relation to the manner of death were included. Titles and abstracts were independently screened against inclusion criteria by two reviewers (MI, MD). Disagreements were resolved by discussion or referred for arbitration to a third reviewer (GP). According to the results obtained from retrieved studies, which may show heterogeneities in categories, forensic characteristics have been classified.

2.2 | Likelihood ratio

Once we identified the recurrent relevant characteristics reported in the included papers, a dichotomic classification for each of them was performed. This classification was achieved in analogy to the classification reported in the original studies, considering all characteristics universally relevant. The LR was calculated as the ratio of frequencies of the evidence under both hypotheses, as follows:

- LR in suicides (LRs)=(number of suicides where X was found/Total Suicides)/(number of homicides where X was found/Total homicides);

- LR in homicides (LRh) = (number of homicides where X was found/Total homicides)/(number of suicides where X was found/Total Suicides);

Where X is the characteristic found. The resulting LR were rounded to the third digit after the decimal point.

2.3 | Application of the LR on real cases

The LR was calculated in six cases of sharp fatalities selected among forensic casework in the time frame 2020–2022. Only cases with a known manner of death were included, specifically those in which all circumstantial data confirmed one of the hypotheses and where the criminal legal proceedings have concluded. We considered each characteristic as independent given the hypothesis, implying that the probability of observing one characteristic is not influenced by the probability of observing any other characteristic. The overall LR for each of the real forensic cases was calculated by multiplying the respective LR of the individual characteristics, as previously suggested [12], and rounded to the nearest unit. The LR was also expressed by a verbal equivalent according to a scale of conclusions as proposed by ENFSI Guideline for Evaluative Reporting in Forensic Science [13].

3 | RESULTS

3.1 | Systematic review

The search was conducted on 19 October 2022 in the Scopus and PubMed databases, yielding 57 and 84 articles respectively, for a total of 141 articles, of which 35 were duplicates and 12 were excluded because they were not published in English. Of the 94 articles screened, 79 were excluded from the title and abstract screening and 16 full-texts were reviewed. Twelve articles were excluded for the reasons listed in Figure 1. Four studies met all inclusion criteria [7, 11, 14, 15].

The database included a total of 527 sharp force fatalities, 173 suicides, and 354 homicides (Table 1).

3.2 | Relevant forensic characteristics in suicides and in homicides and likelihood ratio

Due to the heterogeneity of the characteristics reported, for data extrapolation a dichotomic differentiation for each characteristic was used, whenever feasible in analogy to the classification reported in the original studies, as follows.

All papers [7, 11, 14, 15] reported the gender of the victims (men vs. women).

Two papers [14, 15] provided information about the number of wounds, reporting them as "*single injury*" and "*multiple injuries*." The same classification was used for the purpose of the study.

The following locations were investigated in the studies: neck, thorax, abdomen, crook of the arm, wrist, upper limbs (hand and arm, excluding the two previous areas), and lower limbs. Only the article by Karlsson [15] described the number of sharp force homicides and suicides that reported injuries in specific anatomical regions, allowing LR to be calculated for each of them. Other articles [7, 11, 14] only reported the overall distribution of injuries in suicidal and homicidal cases and cannot be used for the purpose of this study, as frequencies cannot be extrapolated.

The result of toxicological analysis regarding the blood-alcohol presence was reported in three papers [7, 14, 15] as "*under the influence of*" or as "*alcohol detected*." To ensure a broader inclusion, the presence of blood-alcohol was divided into "*detected*" and "*not detected*," even if a cut-off could not be identified due to the absence of quantitative data.

The history of psychiatric illness was reported in two papers [7, 11] as "*present*" and "*absent*," and the same classification was used.

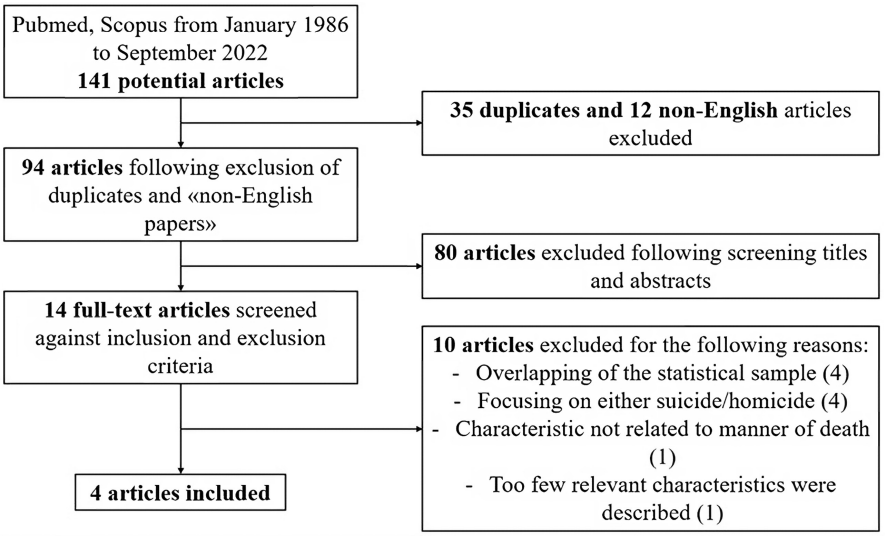

FIGURE 1 Study selection flow diagram.

TABLE 1 The number of suicides and homicides reported in included studies.

	Suicides	Homicides
N.L. Manso et al. (2021) [7]	20	57
C. Terranova et al. (2020) [11]	20	31
M. Vassalini et al. (2014) [14]	28	92
T. Karlsson (1998) [15]	105	174
Total	173	354

Damage to clothing was reported in three papers [7, 11, 15] as "*present*," "*absent*," and "*undetermined*." For the purpose of this study, only the presence or absence of clothing damage was considered.

All of the papers [7, 11, 14, 15], included the place where the body was found, differentiated as "*victims or other person's home*" versus "*other place indoors*" or "*outdoors*" [11, 14, 15], or "*residential unit* vs *outside a residential unit*" [7]. Therefore, for the purpose of this study, the place where the body was found was classified as "*home environment*" and "*outside a residential unit*." Vassalini et al. [14] reported some cases in which the place where the body was found was "*not known*," so these cases were not taken into account.

Due to the high number of existing sharp objects used in fatalities in the included studies [7, 11, 14, 15] (e.g., axe, razor blade, scissor, metal chips, splinters of glass) and considering that the most common sharp object used was a knife, for the purpose of the study the characteristic was divided into "*knife*" and "*sharp object other than knives*." The knife category included kitchen knife, weapon knife, pocketknife, sheath knife, and tool knife. Two articles [7, 11] reported the location of the sharp object in relation to the body's position as "*near the body* or *inside the body*" and "*away from body* or *missing*," and the same classification was used.

Then the absolute frequency and the LR of each characteristic in suicides (LRs) and in homicides (LRh) was calculated (Table 2).

3.3 | Forensic casework presentation and application of the LR

All the included characteristics were identified in our casework and the overall LRh and LRs were calculated in all cases by multiplying the LRs/LRh of each relevant characteristic, as previously reported [6, 12].

3.3.1 | Case 1 – Suicide

A 43-year-old male (LRs = 1.121; LRh = 0.892) was found in his bed (LRs = 1.341; LRh = 0.746), with 46 incised wounds (LRs = 1.040; LRh = 0.961) all over the body sparing only the thorax and the abdomen (neck: LRs = 0.971; LRh = 1.029) (upper limbs: LRs = 0.290; LRh = 3.448) (crook of the arms: LRs = 26.514; LRh = 0.038) (wrist: LRs = 20.880; LRh = 0.048) (thorax: LRs = 2.427; LRh = 0.412) (abdomen: LRs = 1.230; LRh = 0.813) (lower limbs: LRs = 0.151; LRh = 6.638). He was wearing a shirt and shorts. Clothes were undamaged (LRs = 4.121; LRh = 0.243). A pair of large scissors (LRs = 3.662; LRh = 0.273) was found on the floor, a few centimeters from the bed and from the body (LRs = 2.689; LRh = 0.372). He was suffering from schizoaffective disorder and was under psychiatric treatment with olanzapine (LRs = 16.133; LRh = 0.062). Toxicological analysis confirmed the presence of olanzapine in the blood and was negative for alcohol (LRs = 1.950; LRh = 0.513). All data obtained from police investigation and bloodstain patter analysis supported the hypothesis of suicide [16] and the case was filed by the public prosecutor.

The overall LRs and LRh are 140,250 and 7×10^{-6} respectively, indicating that the identified characteristics provide very strong support for the hypothesis of suicide rather than homicide.

3.3.2 | Case 2 – Suicide

A 72-year-old woman (LRs = 0.660; LRh = 1.515) was found dead in her bedroom (LRs = 1.341; LRh = 0.746), with a single (LRs = 0.882; LRh = 1.133) 4 cm vertical stab wound in the abdomen (LRs = 0.360; LRh = 2.776). The clothes worn by the victim showed no damage (LRs = 4.121; LRh = 0.243). No injuries were found to the neck (LRs = 1.014; LRh = 0.986), thorax (LRs = 2.427; LRh = 0.412), upper limbs (LRs = 1.604; LRh = 0.623), crook of the arm (LRs = 0.853; LRh = 1.173), wrist (LRs = 0.412; LRh = 2.428), and lower limbs (LRs = 1.199; LRh = 0.834). A bloodstained knife (LRs = 0.705; LRh = 1.418) was found in the top drawer of her bedside table (LRs = 2.689; LRh = 0.372). She was suffering from major depression (LRs = 16.133; LRh = 0.062). Toxicological analyses were negative for alcohol (LRs = 1.950; LRh = 0.513) and other drugs. All data obtained from police investigation and bloodstain patter analysis supported the hypothesis of suicide [17] and the case was filed by the public prosecutor.

The overall LRs and LRh are 115 and 9×10^{-3} respectively, indicating that the identified characteristics provide moderately strong support for the hypothesis of suicide rather than homicide.

3.3.3 | Case 3 – Suicide

A 47-year-old male (LRs = 1.121; LRh = 0.892) was found dead in his car (LRs = 0.624; LRh = 1.603), with multiple (LRs = 1.040; LRh = 0.961) incised wounds in the wrist (LRs = 20.880; LRh = 0.048). On his lap (LRs = 2.689; LRh = 0.372) a blood-drenched pocketknife (LR = 0.705; LRh = 1.418) was discovered. No injuries were found to the neck (LRs = 1.014; LRh = 0.986), to the upper limbs (LRs = 1.604; LRh = 0.623), to the crook of the arm (LRs = 0.853; LRh = 1.173), to the thorax (LRs = 2.427; LRh = 0.412), to the abdomen (LRs = 1.230; LRh = 0.813), and lower limbs (LRs = 1.199; LRh = 0.834). The clothes worn by the victim showed no damage (LRs = 4.121; LRh = 0.243). The man was suffering from

TABLE 2 Summary table with the absolute frequency, the *p* value and the LR of the relevant characteristics assessed.

Characteristics analyzed	Dichotomic differentiation	No of suicides where the characteristic was found (% of total suicides)	N° of homicides where the characteristic was found (% of total homicides)	Total Suicides[a]	Total Homicides[a]	LR in suicides (LRs)[b]	LR in homicides (LRh)[b]
Gender	Men	143 (82.7)	261 (73.7)	173	354	1.121	0.892
	Women	30 (16.3)	93 (26.3)			0.660	1.515
Number of sharp force injuries	Multiple	103 (77.4)	198 (74.4)	133	266	1.040	0.961
	Single	30 (22.6)	68 (25.6)			0.882	1.133
Neck wounds	Presence	34 (32.4)	58 (33.3)	105	174	0.971	1.029
	Absence	71 (67.6)	116 (66.7)			1.014	0.986
Thorax wounds[c]	Presence	23 (21.9)	118 (67.8)	105	174	0.323	3.096
	Absence	82 (78.1)	56 (32.2)			2.427	0.412
Abdomen wounds	Presence	10 (9.5)	46 (26.4)	105	174	0.360	2.776
	Absence	95 (90.5)	128 (73.6)			1.230	0.813
Upper limb wounds	Presence	14 (13.3)	80 (45.9)	105	174	0.290	3.448
	Absence	91 (86.7)	94 (54.1)			1.604	0.623
Crook of the arm wounds	Presence	16 (15.2)	1 (0.6)	105	174	26.514	0.038
	Absence	89 (84.8)	173 (99.4)			0.853	1.173
Wrist wounds	Presence	63 (60)	5 (2.9)	105	174	20.880	0.048
	Absence	42 (40)	169 (97.1)			0.412	2.428
Lower limb wounds	Presence	3 (2.9)	33 (18.9)	105	174	0.151	6.638
	Absence	102 (97.1)	141 (81.1)			1.199	0.834
Alcohol detection in the blood of the victim	Detected	21 (15.9)	157 (56.9)	132	276	0.280	3.576
	Not detected	111 (84.1)	119 (43.1)			1.950	0.513
History of psychiatric illness	Presence	22 (55)	3 (3.4)	40	88	16.133	0.062
	Absence	18 (45)	85 (96.6)			0.466	2.146
Damage to clothing	Presence	12 (9.3)	163 (77.9)	129	209	0.119	8.384
	Absence	117 (90.7)	46 (22.1)			4.121	0.243
Place where the body was found	Home environment	121 (70.3)	181 (52.5)	172	345	1.341	0.746
	Outside a residential unit	51 (29.7)	164 (47.5)			0.624	1.603
Sharp object (location)	Near the body	33 (82.5)	27 (30.7)	40	88	2.689	0.372
	Away from the body or not found	7 (17.5)	61 (69.3)			0.252	3.961
Sharp object (type)	Knife	94 (63.5)	253 (90)	148	281	0.705	1.418
	Non-knife	54 (36.5)	28 (10)			3.662	0.273

Abbreviations: LRh, Likelihood ratio of the corresponding characteristic in homicides; LRs, Likelihood ratio of the corresponding characteristic in suicides.

[a]The total number of suicides and homicides corresponds to the overall number of cases included in the papers that specifically address each characteristic.

[b]Likelihood ratios for all characteristics included.

[c]For practical reasons for thorax wounds only penetrating wounds were considered.

major depression (LRs = 16.133; LRh = 0.062). Toxicological analyses were negative for alcohol (LRs = 1.950; LRh = 0.513). On the seats a suicide note was found.

The overall LRs and LRh are 18,537 and 5×10^{-5} respectively, indicating that the identified characteristics provide very strong support for the hypothesis of suicide rather than homicide.

3.3.4 | Case 4 – Homicide

A 74-year-old man (LRh = 0.892; LRs = 1121), standing in a bus stop (LRh = 1.603; LRs = 0.624), was stabbed in the throat (LRh = 1.029; LRs = 0.971). The murderer hid the sharp object far from the body (LRh = 3.961; LRs = 0.252), that was later identified

during the trial as a knife (LRh = 1.418; LRs = 0.705). A single wound (LRh = 1.133; LRs = 0.882) was found during autopsy while no injuries were found to the thorax (LRh = 0.412; LRs = 2.427), to the abdomen (LRh = 0.813; LRs = 1.230), to the upper limbs (LRh = 0.623; LRs = 1.604), to the crook of the arm (LRh = 1.173; LRs = 0.853), to the wrist (LRh = 2.428; LRs = 0.412), and to the lower limbs (LRh = 0.834; LRs = 1.199). Clothes damage was absent (LRh = 0.243; LRs = 4.121). No clinical record of a psychiatric illness was present (LRh = 2.146; LRs = 0.466). Toxicological analysis detected a blood alcohol concentration (BAC) of 1.00 g/L (LRh = 3.576; LRs = 0.280). Eyewitnesses were present and the acts were later confirmed by the perpetrator.

The overall LRh and LRs are 9 and 1×10^{-1} respectively, indicating that the identified characteristics provide weak support for the hypothesis of a homicide rather than suicide.

3.3.5 | Case 5 – Homicide

A 45-year-old woman (LRh = 1.515; LRs = 0.660) was stabbed in a public place (LRh = 1.603; LRs = 0.624) to the left leg (LRh = 6.638; LRs = 0.151). Eyewitnesses were present. The clothes the woman was wearing were damaged (LRh = 8.384; LRs = 0.119). A single (LRh = 1.133; LRs = 0.882) sharp force wound was found, while no injuries were found to the neck (LRh = 0.986; LRs = 1.014), thorax (LRh = 0.412; LRs = 2.427), to the abdomen (LRh = 0.813; LRs = 1.230), to the upper limbs (LRh = 0.623; LRs = 1.604), to the crook of the arm (LRh = 1.173; LRs = 0.853), to the wrist (LRh = 2.428; LRs = 0.412). The sharp object was not found (LRh = 3.961; LRs = 0.252) because the murderer ran away before being arrested, so the type of sharp object was unknown. No clinical record of a psychiatric illness was present (LRh = 2.146; LRs = 0.466). Toxicological analysis detected a BAC of 0.85 g/L (LRh = 3.576; LRs = 0.280).

The overall LRh and LRs are 2728 and 4×10^{-4} respectively, indicating that the identified characteristics provide strong support for the hypothesis of a homicide rather than suicide.

3.3.6 | Case 6 – Homicide

A 21-year-old man (LRh = 0.892; LRs = 1.121) was stabbed in a public park (LRh = 1.603; LRs = 0.624), twice (LRh = 0.961; LRs = 1.040), in the chest (LRh = 3.096; LRs = 0.323) and in the back. Eyewitnesses were present and the acts were later confirmed by the perpetrator, who had admitted to using a knife (LRh = 1.418; LRs = 0.705). The sharp force object was hidden by the perpetrator far from the body (LRh = 3.961; LRs = 0.252). At autopsy, no injuries were found to the neck (LRh = 0.986; LRs = 1.014), abdomen (LRh = 0.813; LRs = 1.230), upper limbs (LRh = 0.623; LRs = 1.604), crook of the arm (LRh = 1.173; LRs = 0.853), wrist (LRh = 2.428; LRs = 0.412), or lower limbs (LRh = 0.834; LRs = 1.199). The T-shirt the man was wearing was damaged (LRh = 8.384; LRs = 0.119). No clinical record of a psychiatric illness was present (LRh = 2.146; LRs = 0.466). Toxicological analysis detected a BAC of 0.85 g/L (LRh = 3.576; LRs = 0.280).

The resulting LRh and LRs are 1824 and 5×10^{-4} respectively, indicating that the identified characteristics provide strong support for the hypothesis of a homicide rather than suicide.

4 | DISCUSSION

This paper shows the use of LR in the complex task of distinguishing between suicide and homicide in cases of sharp force fatalities, which often require careful evaluation and the consideration of evidentiary weight. In recent years, scores and mathematical models have been utilized to quantify opinions regarding the manner of death in sharp force fatalities. Karlsson [18] was the first to propose a model to make predictions regarding whether a certain fatality appears more likely to be a homicide or suicide through logistic regression analysis. More recently, Visentin et al. [19] applied a scoring system [20] for the correct framing of suicide caseworks based on statistical frequency of the suicidal method adopted, the victim's history of mental illness, circumstantial data, number of means, and compatibility of means and injuries with suicidal dynamics, to be applied during death scene investigation. Although these papers also presented methods to evaluate the manner of death to be applied in sharp force fatalities, an approach based on an aggregate analysis may provide, using LR, an accessible and comprehensive structure to deal with data uncertainty and logically convey the strength of evidence [21].

After extracting data from included studies and evaluating frequencies in suicidal and homicidal cases, some characteristics that are traditionally associated with manner of death, such as the gender of the victim or the number of injuries [22–24] showed similar frequencies in homicides and in suicides. As expected, other characteristics were strongly associated with manner of death, such as the presence of psychiatric illness, the alcohol detection, or the type and location of the sharp object used [7]. Also, we found that injuries occurring at the thorax and at lower limbs significantly more frequently observed in homicides, while injuries at crook of the arm and wrist were more frequently observed in suicides.

Some characteristics, namely the place where the body was found, the type or location of the weapon, may be defined as "*context information*" [4]. The question about whether context information may be used to influence the expert's decisions has long been addressed in many fields of forensics [25–28]. In forensic pathology, Dror et al. [29] observed that relying on contextual information can be risky, as its objectivity, susceptibility to bias, and relevance can vary. Consequently, errors in determining the manner of death may arise when contextual information is either overemphasized or disregarded too easily. On the other hand, H.H. de Boer et al. [4], stated that only context information that influences the LR is relevant for the expert, as long as all characteristics used to calculate the LR are explicated to the trier-of-fact, not only

because they are important to understand the basis of the expert's opinion, but because they help to consider the effect of context information on the expert's opinion, preventing the so-called "*double counting of evidence*" [4].

When calculating the LR in a real case, we found that the total LRs ranged from 115 to 140,250 in suicidal cases, whereas the total LRh ranged from 9 to 2728 in homicidal cases. Expressing the LR by a verbal equivalent [13], we obtained "very strong support" (cases 1 and 3) and "moderately strong support" (case 2) for the suicidal death hypothesis, and "weak support" (case 4) and "strong support" (cases 5 and 6) for the homicidal death hypothesis. The LRs obtained are low compared to other fields of forensic science where this approach is widely used. Nevertheless, in forensic pathology, there is a great deal of information that should be evaluated by the trier of fact that is outside the scope of expert evidence. Indeed, in the six cases presented, evidence independent of the physical findings at the scene and on the body clearly indicated that some of the deaths were homicides, regardless of the LR. A correct understanding and interpretation of the case requires consideration of these contextual factors. The proposed approach helps the forensic pathologist to form and support an opinion based on characteristics gathered mainly during the death scene investigation, the autopsy and other post-mortem data, and serves as a tool to interpret the evidence in a logically correct way.

4.1 | Limitations and future perspectives

The literature review revealed that, although numerous studies have examined cases involving sharp force fatalities, only a limited number of papers have provided comprehensive descriptions of forensic characteristics that can be gathered and analyzed independently in a larger dataset.

Moreover, a significant level of descriptive heterogeneity was found among the reviewed articles. For instance, many of them failed to specifically mention important forensic aspects such as the presence of defense injuries, hesitation marks, and psychiatric history. The lack of key forensic details in most cases was previously emphasized by certain authors [22, 23], who observed that the localization of the lesion is sometimes described only in vague or general terms, which hampers comprehensive analysis across studies.

In this study, as the frequencies of single characteristics were derived from descriptive retrospective studies, it was not feasible to separate data from each individual case or examine injuries and other characteristics as dependent variables. This led to the infeasibility of applying a Bayesian network, ideal to visualizes dependencies between variables and the flow of information between these variables while estimating the joint probability distribution of data, as each relevant characteristic has been assessed independently [21]. As a result, the method presented does not enable a thorough assessment of the evidence through a comprehensive and integrated logical analysis. Such an evaluation is a crucial task that should be entrusted to a forensic expert who possesses the necessary expertise to conduct a comprehensive analysis. The main challenges of research in forensic pathology relies in the identification of new strategies in descriptive studies, as one of the major Learning Objectives of the American Academy of Forensic Science (AAFS) Continuing Education Program [30].

5 | CONCLUSIONS

The LR helps to maintain the separate roles of the trier-of-facts and the expert and could be implemented in forensic casework to assess its robustness also in forensic pathology. To be able to extensively apply the LR in the field of sharp force fatalities, as in other violent fatalities, it will be necessary to standardize the methodology of investigation and data collection in descriptive studies, and to validate the LR approach on a larger casework.

CONFLICT OF INTEREST STATEMENT

The authors have no conflicts of interest to declare.

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