

Anny Sauvageau,¹ M.Sc., M.D.; Anny Godin,¹ B.Sc.; Sébastien Desnoyers¹; and Célia Kremer,¹ M.Sc.

Six-Year Retrospective Study of Suicidal Hangings: Determination of the Pattern of Limb Lesions Induced by Body Responses to Asphyxia by Hanging*

ABSTRACT: The objective of the present study was to estimate the proportion of hanging victims presenting with limb lesions, to compare this rate between hanging in restraint spaces and in more open settings, and to describe the usual pattern of limb lesions associated with hanging. Two hundred and seven cases of suicidal hanging were retrospectively reviewed and compared to 45 homicidal nonhanging strangulation victims. Bruises incidence was significantly lower in hanging victims (19.8%) compared to homicidal strangulation victims (55.6%). Bruises were more commonly encountered in restraint areas such as closets and staircases (56.3% and 66.7%, respectively) than in more open settings such as barn, bridge, fence, and park. Limb bruises on hanging victims were generally located on the posterior upper limb or the anterior lower limbs, whereas strangulation victims did not display this preferential bruises concentration. Possible suspicion criteria for limb bruises distribution are discussed, in relation to physiopathology of human asphyxia by hanging.

KEYWORDS: forensic science, asphyxia, hanging, strangulation, suicide, homicide, ecchymosis, limb, pathophysiology

External examinations of hanging victims occasionally reveal bruises or lacerations. Such findings may raise suspicion of foul play or homicide. However, recent studies of filmed hangings demonstrated that asphyxia by hanging is associated with a complex pattern of body movement responses, with not only convulsions but also alternating phases of decerebrate and decorticate rigidity (1,2). Considering this sequence of body movements, it seems possible that hanging victims may hurt themselves, especially in hanging in restraint areas.

The objective of the present study was to estimate the proportion of hanging victims presenting with limb lesions, to compare this rate between hanging in restraint spaces and in more open settings, and to describe the usual pattern of limb lesions associated with hanging.

Materials and Methods

All cases of suicidal hanging (239 cases) autopsied over a 6-year period (2000–2005) at the centralized forensic laboratory of the Quebec province, Canada, were retrospectively reviewed for the presence of limb lesions. Of these, victims presenting a combination of hanging and other injury modalities (complex suicides, six cases) were excluded from the analysis, as well as cases presenting significant postmortem changes (advanced decomposition, skeletal and charred bodies, 26 cases). Overall, a total of 207 cases were considered for the present study. Location of suicide was noted

according to information available in the coroner's autopsy request, police report and, when available, crime scene charts and pictures.

For each case, the presence of bruises, abrasions, and lacerations on both lower and upper limbs was documented according to autopsy report, diagrams, and photographs. Yellow colored bruises were not considered. Each lesion was drawn on anterior and posterior standard anatomical charts.

In comparison, victims of nonhanging type homicidal strangulation were similarly studied. In the 6-year period study, 69 cases were autopsied in our laboratory. Of those, seven cases were excluded because of significant postmortem changes and 17 cases, for presence of other type of traumatism (e.g., injuries by sharp force or blunt head trauma).

Data were statistically analyzed using the SPSS 15.0 software (SPSS Inc. Technology, Chicago, IL) at a threshold of significance set at 5%.

Results

Incidence of Limb Lesions

External examination of suicidal hanging victims revealed limb abrasions in 31.9% of cases (CI 95% 25.3; 38.5) and bruises in 19.8% (CI 95% 14.1; 25.5). None of the victims presented limb laceration. Compared to homicidal strangulation victims, suicidal hanging victims are less likely to present limb bruises ($p < 0.05$) (Table 1). As for abrasions, the incidence is relatively similar in both groups.

Incidences of Bruises in Relation to Hanging Location

Incidences of limb bruises in relation to hanging location are presented in Table 2 and Fig. 1. The two highest incidences of limb bruises were recorded for hanging in staircases and closets

¹Laboratoire de Sciences Judiciaires et de Médecine Légale, Edifice Wilfrid-Derome, 1701, Parthenais Street, 12th Floor, Montreal, QC, Canada, H2K 3S7.

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TABLE 1—General incidence of limb lesions in suicidal hanging and homicidal nonhanging strangulation.

	Suicidal Hanging (%)	Homicidal Nonhanging Strangulation (%)
Bruises	19.8	55.6
Erosions	31.9	33.3
Lacerations	0.0	0.0

TABLE 2—Incidence of limb bruises in relation to hanging location.

Location	Cases		Bruises	
	n	%	n	%
Staircase	9	4.3	6	66.7
Wardrobe	16	7.7	9	56.3
Living room	4	1.9	1	25.0
Lobby/Hallway	4	1.9	1	25.0
Bathroom	17	8.2	4	23.5
Basement	23	11.1	5	21.7
In custody	63	30.4	10	15.9
Undetermined—Residence	13	6.3	2	15.4
Shed	10	4.8	1	10.0
Woods/Vacant lot	13	6.3	1	7.7
Garage/Workshop	14	6.8	1	7.1
Boat	1	0.5	0	0.0
Isolating room	1	0.5	0	0.0
Kitchen	4	1.9	0	0.0
Park/Picnic table	2	1.0	0	0.0
Bedroom	8	3.9	0	0.0
Fence/Outside wall	2	1.0	0	0.0
Bridge	2	1.0	0	0.0
Barn	1	0.5	0	0.0
Total	207	100.0	41	19.8

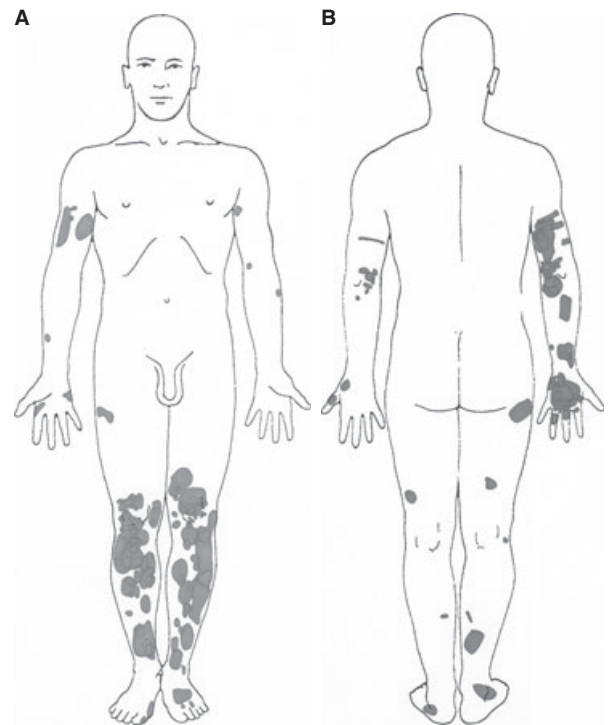


FIG. 2—Schematic superimposition of limb bruises in suicidal hanging victims. (A) Anterior view, (B) posterior view.

(Table 3). In contrast, bruises incidences were very low for hangings in locations such as barn, bridge, fence, and park.

In our population, the most common hanging location was in custody (30.4%), followed by basement (11.1%) and bathroom (8.2%). Bruises incidences in those three locations varied from 15.9% to 23.5%.

Usual Pattern of Limb Bruises in Suicidal Hanging

Combined anatomical charts were drawn, superimposing bruises from each individual case of suicidal hanging (Fig. 2). Looking at those charts, limb bruises appeared to be mostly found on the posterior part of upper limbs, especially on the right arm, and on the anterior aspect of lower limbs. Very few bruises were found on anterior upper limbs or posterior lower limbs in suicidal hanging: 81.8% of arm bruises were located on the posterior part of the limb (the posterior aspect of the right arm being implicated in 63.7%) and 84.6% of leg bruises were on the anterior part. Comparative charts in homicidal nonhanging strangulation did not display this preferential bruises concentration and a higher dispersion of bruises were noted (Fig. 3).

Bruises in suicidal hanging victims were located on the upper limbs in 36.6%, the lower limbs in 46.3%, and on both limbs in

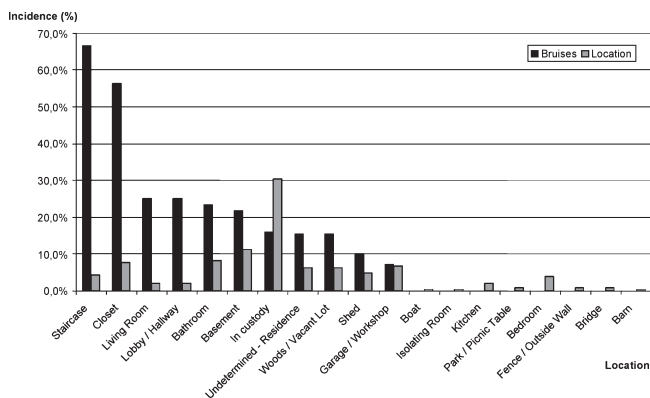


FIG. 1—Incidence of limb bruises and hanging locations.

(66.7% and 56.3%, respectively). These two locations were associated with a significantly higher bruises incidence compared with all other locations, except for living room, and lobby/hallway

TABLE 3—Statistical comparison of bruises incidence between locations—table of p value*.

Locations	In Custody	Undetermined—Residence	Shed	Woods/Vacant Lot	Garage/Workshop	Basement	Bathroom	Lobby/Hallway	Living Room
Staircase	0.001	0.02	0.017	0.007	0.02	0.025	0.042	0.217	0.217
Wardrobe	0.002	0.029	0.023	0.006	0.006	0.031	0.058	0.291	0.291
Living room	0.521	0.579	0.505	0.426	0.405	—	—	—	—
Lobby/Hallway	0.521	0.579	0.505	0.426	0.405	—	—	—	—
Bathroom	0.339	0.469	0.371	0.261	0.233	—	—	—	—
Basement	0.366	0.501	0.395	0.276	0.246	—	—	—	—

*Statistically significant results shown in grey.

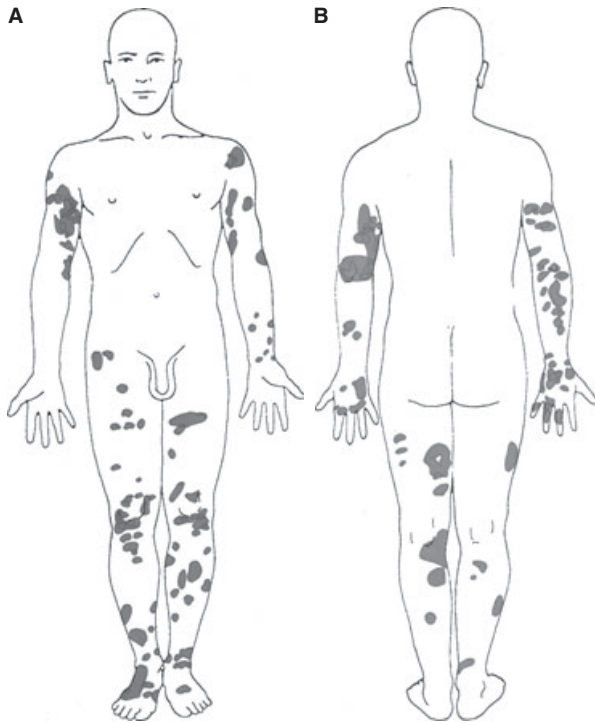


FIG. 3—Schematic superimposition of limb bruises in homicidal non-hanging strangulation victims. (A) Anterior view, (B) posterior view.

17.1%. Comparatively, 52% of homicidal strangulation victims presented with bruises on both upper and lower limbs.

Statistical Evaluation of Possible Suspicion Criteria for Limb Bruises Distribution

Limb bruises in suicidal hanging are not commonly encountered (i) on anterior aspect of upper limbs, (ii) on posterior aspect of lower limbs, and (iii) on both upper and lower limbs. Therefore, those three findings were proposed as possible suspicion criteria alerting to the possibility of foul play. Pearson chi-square contingency analysis was used to assess the validity of those criteria (Tables 4–6). Anterior upper limb bruises and bruises on both

TABLE 4—Presence of bruises on anterior upper limbs.

	Suicidal Hanging (%)	Homicidal Nonhanging Strangulation (%)
All cases*	3.4	26.7
Cases with upper limb bruises [†]	31.8	60.0

*Pearson's chi-square $\alpha = 0.000$, contingency coefficient = 0.320.

[†]Pearson's chi-square $\alpha = 0.067$, contingency coefficient = 0.272.

TABLE 5—Presence of bruises on posterior lower limbs.

	Suicidal Hanging (%)	Homicidal Nonhanging Strangulation (%)
All cases*	3.4	13.3
Cases with lower limb bruises [†]	17.1	24.0

*Pearson's chi-square $\alpha = 0.006$, contingency coefficient = 0.170.

[†]Pearson's chi-square $\alpha = 0.471$, contingency coefficient = 0.11.

TABLE 6—Presence of bruises on both upper and lower limbs.

	Suicidal Hanging (%)	Homicidal Nonhanging Strangulation (%)
All cases*	3.4	28.9
Cases with bruises [†]	17.1	52.0

*Pearson's chi-square $\alpha = 0.000$, contingency coefficient = 0.340.

[†]Pearson's chi-square $\alpha = 0.003$, contingency coefficient = 0.346.

TABLE 7—Combined criteria: anterior upper limb bruises and bruises on both upper and lower limbs.

	Suicidal Hanging (%)	Homicidal Nonhanging Strangulation (%)
All cases*	4.5	50.0

*Pearson's chi-square $\alpha = 0.001$, contingency coefficient = 0.459.

upper and lower limbs were confirmed as statistically significant criteria, whereas posterior limb bruises was not. By combining both statistically valid criteria together, a rather strong contingency coefficient of 0.459 was reached (Table 7).

Discussion

Limb bruises incidence and pattern in hanging have been largely overlooked in the literature up to now. At best, one or two sentences about bruises are sometimes found in studies focusing on other aspects of hanging. In Uzun et al., it is mentioned that 56 cases out of 761 (7.4%) suicidal hangings presented superficial bruises "attributed to result from the trauma during the agonal period" (3). In another Turkish study on 56 suicidal hangings, it is written that two cases (3.6%) presented body ecchymosis, without any further details (4). In an older German study, 20% of the 107 suicidal hanging cases showed "lesions in various locations, which are thought to be results of terminal convulsions" (5). Finally, a 10% rate of body bruises was observed in a study by Cooke and Samarasekera, on 233 hangings (6).

The present study has the higher rate of limb bruises ever reported, with 19.8% of victims. However, this rate varied widely depending on the hanging location, ranging from 0% in more open settings (e.g., barn, bridge, fence, park) to over 50% in restraint areas (e.g., staircases and closets).

Limb bruises in hanging are more prone to be located on posterior upper limb and anterior lower limb. More often than not, in a single case, bruises are located on the upper limb or the lower limb but not on both. As far as we know, this study is the first one to describe the usual pattern of limb bruises in hanging.

In studies of filmed hanging (1,2), it was demonstrated that asphyxia by hanging is associated with a complex pattern of body movement responses. Loss of consciousness is closely followed by convulsions and alternating phases of decerebrate and decorticate rigidity. Arms are abruptly flexed in the quick and sudden phase of decortication. In contrast, arms are extended away from the body in the decerebration rigidity. In more recently acquired filmed hangings by the Working Group on Human Asphyxia (WGHA), not published yet, we see a man violently bumping the back of his arm on the wall behind during one decerebration movement. Although less impressive, legs are moving as well, alternating

between flexed and extended positions. In another unpublished filmed hanging of the WGHA, the legs of a man in a forward bend kneeling hanging position are suddenly extended, the knees impacting on the floor in the movement. Therefore, the observed usual pattern of bruises is making sense on a pathophysiological point of view. It is also worth mentioning that despite traditional assumptions that the type of suspension (e.g., complete, standing, sitting, lying down) would influence significantly the hanging time before death or the body responses to asphyxia, this was not observed in the WGHA studies so far. In the present study, pattern of bruises was not correlated with the type of suspension.

In the evaluation of a given case, the presence of posterior arm bruises or anterior legs bruises are not generally suspicious of foul play. However, it seems that the presence of anterior arm bruises or bruises on both upper and lower limbs should alert the pathologist to be more cautious. Of course, bruises location is not to be interpreted without all other scene elements and autopsy findings.

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Additional information and reprint requests:

Anny Sauvageau, M.D., M.Sc.
 Laboratoire de Sciences Judiciaires et de Médecine Légale
 Édifice Wilfrid-Derome
 1701, Parthenais Street, 12th Floor
 Montreal, QC H2K 3S7
 Canada
 E-mail: a.sauvageau@mssp.gouv.qc.ca