Int J Legal Med (2011) 125:863–871
DOI 10.1007/s00414-011-0622-1

ORIGINAL ARTICLE

Haemorrhages into the back and auxiliary breathing muscles after death by hanging

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Received: 15 June 2011 / Accepted: 7 September 2011 / Published online: 21 September 2011

Abstract We describe and discuss haemorrhages discovered in the back and auxiliary breathing muscles of a population of cases of suicidal death by hanging. Intramuscular haemorrhages were present in approximately 30% of the cases. Pre-existing illnesses with an increased tendency to bleed or an anticoagulant medication did not exist; corresponding skin and subcutaneous fatty tissue structures were intact in each case. In cases of death by hanging, the occurrence of muscle haemorrhages of this type may be explained pathophysiologically by the occurrence of increased respiratory exertions and/or seizures during the hanging process. Although the results of our study do not indicate an obligatory autopsy finding, evidence of internal haemorrhaging into the back and auxiliary breathing muscles may be called upon following consideration of differential diagnostic aspects as a further diagnostic indication of vital hanging.

Keywords Intramuscular haemorrhages · Vitality signs · Hanging · Suicide · Autopsy

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Electronic supplementary material The online version of this article (doi:10.1007/s00414-011-0622-1) contains supplementary material, which is available to authorized users.

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Introduction

It is a well-known fact that death by hanging is a complex process. It is not only complex in terms of the pathophysiological course of events leading to death [1, 2] but is also in part non-uniform in relation to the external circumstances [3, 4]. Documented observations originate from both few cases in which suicides filmed their own death—as currently reported by Sauvageau [5]—and from judicial hangings, as described in the past by Miloslavich [6], Seyfarth [7], Kalle [8] and Dobson [9]. In order to exclude foul play, one's aim of autopsy on a person found hanged will be to clarify whether this person hanged himself or herself or was hanged whilst alive or was placed in a hanging situation as a corpse, for instance as a cover-up for homicide [10, 11]. In addition to evidence at the scene where the corpse is discovered and a lack of defensive injuries, vitality signs in the body may serve this end. Local macro- and micro-morphological evidence of vital hanging include several investigations about morphology and vitality signs of the strangulation mark, e.g. a double zone of hyperaemia above and below as well as congestion

haemorrhages above the ligature mark. As systemic reactions, a positive phosphatidic sample [12], pulmonary dystelectasis and pulmonary microembolism syndrome [13], and occasionally pulmonary embolisms, aspiration findings and haemorrhages of the intestinal wall [12, 14–16] have also been described. Since, however, individual morphologically discernible findings, such as haemorrhages under the anterior longitudinal ligament of the vertebral column, are neither specific nor sensitive [17–19]. In some cases, considerable doubts as to their vital origin are expressed, and these findings may also be provoked post-mortally [12, 20], as many vitality signs as possible should be called upon in order to classify the type and cause of death and to be able to exclude post-mortal hanging as a homicide cover-up on the basis of a combination of the results of criminal police investigations, inspection of the scene where the body was found as well as autopsy findings.

In cases where the post-mortem examination of a hanged person reveals in the back and auxiliary breathing muscles intramuscular haemorrhages of exogenous origin involving the skin and/or the corresponding subcutaneous fatty tissue, it is necessary first to distinguish between injuries inflicted by another person, for example in the course of a prior physical alteration, and those arising during the hanging process as a result of bumping into objects, furniture etc. in the course of seizures [21]. Such findings may also be a result of resuscitation attempts in the sense of agonal/post-mortal abutment haemorrhages over prominent bony structures on the back of the body (shoulder blades, spinous processes of the vertebrae) as a sufficient resuscitation must take place in supine position on a hard surface [22]. An entirely post-mortal origin in the sense of internal livor mortis would also be conceivable in the event of early discovery, recovery and depositing of the body on the ground [23]. In this case, accurate knowledge of the facts as well as the position in which the body was found and recovered is essential for differentiation purposes [3].

In general, exogenously inflicted and endogenously incurred muscular haemorrhages will be successfully differentiated in the course of forensic autopsy by preparation of the skin and corresponding subcutaneous fatty tissue over the muscular haemorrhage. Evidence for vitality may subsequently take place by assignment to the histological criteria “pre-mortal (vital–agonal)”, “indifferent” or “post-mortal (areactive)” as formulated by Sigrist and Hauser amongst others [24–27]. Moreover, such muscular haemorrhages have also been subjected to immunohistochemical and ultrastructural investigation by Fechner et al. [28–30].

Vital haemorrhaging into the back and auxiliary breathing muscles without corresponding haemorrhaging into the subcutaneous fatty tissue or the skin are, however, a non-specific finding which is occasionally encountered in the course of forensic autopsies dependent on the cause of death; thus, such findings were already reported more than 100 years ago in connection with death by drowning, for instance, by Paltauf [31], more recently by Carter [32] and in about half of the deaths in a prospective autopsy study by Püschel et al. [33]. In cases of natural death from cardiac and pulmonary causes too, haemorrhages in the back and auxiliary breathing muscles without corresponding haemorrhages in the subcutaneous fatty tissue or the skin were observed [34, 35].

As early as 1922, Reuter reported on haemorrhages found in the back and auxiliary breathing muscles after death by strangulation [36]; in this context, haemorrhaging in the muscles of the tongue and the back of the neck was also reported [37, 38]. From a pathogenetic point of view, these haemorrhages are to be accounted for by muscles ruptured as a result of increased and convulsive respiratory activity in the agony phase. In the event of death by obstructive asphyxia, in particular, convulsive efforts to breath in the dyspnoea phase as well as tonic–clonic asphyxiation seizures in the sense of a vital/agonal reaction were observed in animal experiments [39, 40]. As not only a dyspnoea phase and a seizure stage but also convulsions between 10 and 19 s are described during the hanging process [41–43], vital haemorrhaging into the back and auxiliary breathing muscles without corresponding haemorrhaging into the subcutaneous fatty tissue or the skin might also be explainable in such cases.

Material and methods

In 2006, we were able to report about the first results of an autopsy study on the occurrence of haemorrhaging into the back and auxiliary breathing muscles in cases of death by hanging [44]. In the context of the continuation of this survey, the localisation, intensity, size and shape of the haemorrhages and intramuscular ruptures were described in all cases of death by hanging autopsied from 2005 to 2008 at the Department of Forensic Medicine of the University Medical Centre Hamburg-Eppendorf by means of layered preparation of the muscles of the torso, the neck, the pectoral girdle and the upper arm. The relevant autopsy reports and investigation files were then recorded and evaluated in respect of gender, age, height, weight, body mass index (BMI), post-mortal interval, putrefaction, type of hanging, signs of congestion in the head and neck area, resuscitation attempts carried out, characteristics and localisation of haemorrhages of the intestine walls, haemorrhaging into the back and auxiliary breathing muscles, Simon's bleedings, previous illnesses and degree of alcoholisation or toxicologically relevant substance influence at the time of death. More highly putrefied bodies were excluded from

the study for reasons of limited suitability for assessment; corpses with incipient changes through putrefaction in the sense of greenish putrid abdominal walls were included in the study. The cases of death by hanging were further divided into a

(a) Group with haemorrhaging into the back and auxiliary breathing muscles recorded in the autopsy report as well as a
(b) Group with no description of haemorrhaging into the back and auxiliary breathing muscles described in the autopsy report.

In cases of muscle haemorrhages after death by hanging, the anatomical–topographical assignment was made first, then the evaluation of the relevant histological tissue sections; this revealed macroscopically blood-filled areas of the muscle. Then the following classification following histological criteria was undertaken: pre-mortal (vital/agonal), indifferent and post-mortal (areactive). Lung tissue was also examined for the existence of pulmonary fat embolism. The following staining was performed: elastic van Gieson, phosphotungstic acid haematoxylin and haematoxylin–eosin.

In the group without description of haemorrhaging into the back and auxiliary breathing muscles described in the autopsy report, a histological processing of the muscle sections described at autopsy as unremarkable was not possible; this was due to the fact that in cases of macroscopically normal findings, no corresponding tissue sections were preserved for tissue analysis. Lung tissue was not examined in this group.

Statistic evaluation

For examination of statistic significances concerning differences of the frequency between groups, we used the two-sided *t* test [45].

Results

The overall study population ($n=62$) consisted of 51 men and 11 women. All were suicides; on the basis of the autopsy findings, all the deaths were classified as vital hangings. The median age was approximately 49.5 years (±15.7 SD). The median height was 175.5 cm (±7.6 SD) and the median weight 72.5 kg (±13.3 SD), making the median BMI 23.5 kg/m² (±3.4 SD). As far as this could be reconstructed, 60 h (± 31.3 SD) passed between death and autopsy. Twenty-one of the bodies displayed incipient changes through putrefaction in the form of greenish putrid abdominal walls; 41 of the deceased manifested no signs of putrefaction at autopsy. Thirty-eight of the deceased had hanged themselves typically (free suspension without contact to the ground and knot centred in the back of the neck); 24 hanged persons had contact with the ground. Signs of congestion in the head and neck region were present in 18 cases. Only in six cases had resuscitation attempts preceded certification of death.

In six cases, haemorrhaging into the intestinal walls in the sense of posited abdominal congestion symptoms [16] was attested. Thirty-one deaths displayed haemorrhages under the anterior longitudinal ligament of the vertebral column. In 29 cases, previous illnesses were present; for the most part, these affected the cardiovascular and respiratory system and in no case were associated with a pathologically increased tendency to bleed. Twenty of the deceased were under the influence of alcohol, some of them considerably (between 0.05‰ and 2.76‰). Toxicologically relevant findings were only substantiated in two cases: in one case, a non-lethal intoxication with a combination of methadone and diazepam was ascertained and in a second case, an overdose of non-steroidal antirheumatics was established. In a further case, diazepam abuse existed anamnestically, but this could not be confirmed for the time of death.

Amongst all the cases of death by hanging investigated retrospectively, the relevant autopsy reports in 18 cases (29.03%) indicated haemorrhaging into the back and auxiliary breathing muscles. In the remaining 44 cases of death by hanging (70.96%), no indications could be found in the autopsy reports for the presence of haemorrhaging into the back and auxiliary breathing muscles. An overview of all the parameters surveyed in the entire study group is available as electronic supplemental material (ESM).

Group with haemorrhaging into the back and auxiliary breathing muscles

This population consisted of 14 men and 4 women; the median age was approximately 53.5 years (±12.0 SD). The median height was 174 cm (±6.0 SD) and the median weight 72.7 kg (±11.9 SD), making the median BMI 24.7 kg/m² (±3.6 SD). As far as reconstructable, 57 h (±24.5 SD) passed between death and autopsy. Four of the deceased displayed incipient putrefaction changes in the form of greenish putrid abdominal walls. Nine of the deceased had hanged themselves typically (free suspension without contact to the ground and knot centred in the back of the neck), a further nine hanged persons had contact with the ground. Signs of congestion in the head and neck region were present in seven cases. In none of the cases had resuscitation attempts been made. Two of the deceased displayed haemorrhaging into the intestinal walls; 7 of the 18 deaths presented haemorrhages under the anterior longitudinal ligament of the vertebral column. In nine cases, previous illnesses of the cardiovascular and respiratory systems existed from the autopsy findings; medical files were not available in these cases. Six of the deceased

were under the influence of alcohol, some of them considerably (between 0.09‰ and 2.19‰); all other toxicological tests remained negative. Notably, no intoxication with centrally acting substances which might suppress respiratory activity was found. Furthermore, there were no hints for ingestion of anticoagulants such as acetylsalicylic acid, clopidogrel or phenprocumone.

Table 1 shows the muscle haemorrhage findings in the haemorrhage group. Amongst the muscles into which haemorrhaging occurred the musculus infraspinatus dominated (11 out of 18 cases), followed by the musculus supraspinatus and the musculus subscapularis (5 cases each). The total of 59 muscle haemorrhages detected frequently occurred bilaterally; no preference for a particular side was demonstrated (32 haemorrhages in the left-hand side of the body, 27 in the right-hand side). Very infrequently, circumscribed muscle ruptures were observable, also with formation of smaller haemorrhage cavities. The haemorrhages impressed as fresh and for the most part massive (Figs. 1 and 2). In no case did the corresponding subcutaneous fatty tissue and the skin display signs of injury.

Histology

In 11 of the 18 cases (61.1%), areas of muscle haemorrhage preserved at autopsy were histologically prepared and analysed; in the remaining 7 cases, relevant preserved tissues were not available or were strongly autolytic after a lengthy storage period despite fixing in formalin. Classification of the histological findings of the survey was based on the criteria presented in Table 2 [24, 25, 27, 33, 35, 46]. Eight of the 11 cases which underwent histological examination displayed changes in the muscle fibres consistent with pre-mortal (vital/agonal) origin: e.g. discoid and segmental fibre disintegration within the sarcolemma tube which was frequently still preserved, often with hourglass deformation, with replacement of cross striation by longitudinal striation at concave rupture points (Fig. 3). In seven of these eight cases, muscle fibre changes were likewise found such as may also be observed in the indifferent type of muscle fibre alteration (not suitable as a sign of vital reaction), e.g. a wave-like formation of muscle fibres and hypercontraction bands (Fig. 4). In 3 of the 11 cases, muscle changes of an areactive type were present in combination with changes of indifferent type. Haemorrhages of the vital type (mostly a star-shaped configuration with a centrifugal spread of bleeding) were found in 7 of the 11 cases (Fig. 5). The ascertained muscle fibre changes lay predominantly in the area of haemorrhaging. In no case was it possible histologically to detect a pulmonary fat embolism.

Group with no description of haemorrhaging into the back and auxiliary breathing muscles

The 44 cases of death by hanging included 37 men and 7 women; the median age was approximately 43.5 years

Table 1 Location of intramuscular haemorrhages in the haemorrhage group

Gender	Age (year)	Height (cm)	Weight (kg)	Macroscopic distribution of muscle haemorrhages after death by hanging									
				Musculus infraspinatus	Musculus supraspinatus	Musculus subscapularis	Musculus trapezius	Musculus rhomboideus	Musculus serratus posterior superior	Musculus deltoideus	Musculus erector spinae	Musculus biceps brachii	Musculus triceps brachii
F	61	162	68.0	Bilateral	–	Bilateral	–	–	–	–	–	–	–
M	46	174	98.4	Bilateral	–	Bilateral	–	–	–	–	–	–	–
M	35	179	81.0	–	–	–	–	–	Right	–	–	–	–
M	72	183	92.4	Bilateral	Right	–	–	–	–	–	–	Right	–
M	56	175	64.9	Bilateral	–	–	Bilateral	–	–	–	–	–	–
M	65	170	64.2	Right	–	–	–	Bilateral	–	Bilateral	–	–	Bilateral
F	72	174	65.0	–	–	–	–	Left	–	–	–	–	–
M	54	178	78.8	Left	–	Left	–	–	–	Right	–	–	–
M	52	174	83.5	Left	–	–	Right	–	Left	–	–	–	–
M	47	175	63.1	–	Bilateral	–	–	–	–	–	–	–	–
M	41	175	73.3	Right	–	–	–	–	–	–	–	–	–
M	50	174	93.5	Left	Left	–	–	–	–	–	–	–	–
M	65	170	71.0	Bilateral	Bilateral	–	–	–	–	–	–	–	–
M	39	185	73.5	–	–	–	–	Bilateral	–	–	–	–	–
F	37	165	64.0	–	–	Left	–	–	–	–	–	–	–
F	53	164	72.0	Bilateral	Bilateral	–	Left	Left	–	–	Left	–	–
M	72	174	93.8	–	–	Bilateral	–	–	–	–	Right	–	–
M	54	169	65.0	–	–	–	Left	–	Left	–	–	–	–

Fig. 1 Massive fresh haemorrhaging into the left musculus infraspinatus. Overlying skin and subcutaneous fatty tissue with no signs of injury

(±16.6 SD). The median height was 177 cm (±8.1 SD) and the median weight 72.5 kg (±13.9 SD), making the average BMI 23.2 kg/m² (±3.2 SD). As far as reconstructable, 60.5 h (±33.5 SD) passed between death and autopsy. Seventeen of the bodies displayed decomposition changes in the form of greenish putrid abdominal walls; 27 displayed no signs of decomposition at autopsy. Twenty-nine of the deceased had hanged themselves typically (free suspension without contact to the ground and knot centred in the back of the neck); 15 hanged persons had contact with the ground. Signs of congestion in the head and neck region were present in 11 cases. In six cases, resuscitation attempts had been undertaken.

Four of the deceased displayed haemorrhaging into the intestinal walls; 24 presented haemorrhages under the anterior longitudinal ligament of the vertebral column. In 20 cases, previous illnesses existed, mostly of the cardiovascular and respiratory systems. Fourteen of the deceased were under the influence of alcohol, some of them considerably (between 0.05‰ and 2.76‰). As mentioned above, toxicologically relevant findings were only substantiated in two cases. In particular, there were no hints for ingestion of anti-coagulants such as acetylsalicylic acid, clopidogrel or phenprocumone. Neither histological processing of macroscopically normal muscle samples nor lung tissue was performed.

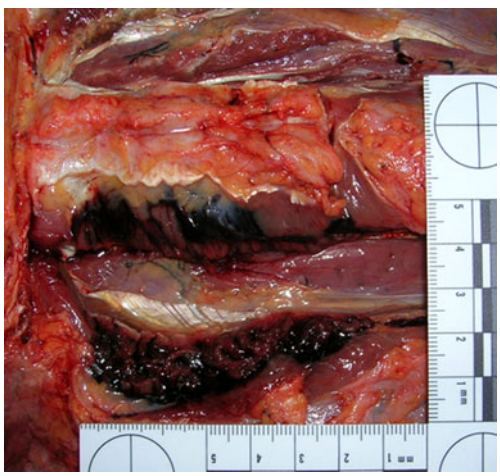

Fig. 2 Fresh haemorrhaging into the left musculus rhomboideus. No haematoma in neighbouring fatty tissue

Statistic results

A significant connection between the occurrence of intramuscular haemorrhages and all other parameters recorded in both groups was not found. Although the median age was different between both groups, this distinction was not significant (two-sided t test, $p=0.076$).

Discussion

The autopsy diagnosis of “haemorrhages in the back and auxiliary breathing muscles” when a post-mortem examination is carried out on hanged persons initially implies a range of differential diagnostic considerations on the part of the pathologist; in this context, there is a need to discuss a mechanical, traumatic origin (abutment haemorrhage in the state following resuscitation, other blunt force trauma to the body) as well as autolysis, decomposition artefacts and post-mortal formation. Furthermore, other possible triggers for muscle haemorrhages which must be considered are, for instance, diapedesis haemorrhages in illnesses such as congenital or acquired blood clotting disorders (e.g. disseminated intravascular coagulation or septicaemia) or terminal hypothermia [47–50].

We were able to exclude putrefaction artefacts as a cause of muscle haemorrhages in the haemorrhage group; only 4 of the 14 cases (28.5%) displayed decomposition changes, and these were at most slight. We were not able to confirm a mechanical/traumatic origin of the areas of muscles into which haemorrhaging occurred due to iatrogenic measures in the haemorrhage group as in no case with positive haemorrhage findings resuscitation attempts had taken place, and resuscitation attempts in the group without haemorrhages had not led to the occurrence of muscle haemorrhages. Moreover, no case revealed indications of another mechanical/traumatic origin of muscle haemorrhages. Indications of hypothermia at the time of death could not be elicited. Moreover, none of the deceased suffered from previous illnesses or intoxications which could provide an explanation for an increased tendency to

Table 2 Histological criteria for the chronological classification of areas of muscles suffering haemorrhaging

Histomorphology	Classification
Haemorrhage sites, some with a star-shaped structure, fading towards the periphery, characterised by a cobweb-like structure in the sense of an active displacement or spreading apart of the muscle fibres due to intervening blood cells	Pre-mortal (vital/agonal)
Granular, segmental or discoid disintegration of the fibres	
Invaginated contraction caps	
In places, noticeable longitudinal striation with loss of cross striation	
Concave intra-sarcolemmal ruptures with an empty sarcolemma	
Pre-ruptures with retention of the muscle membranes in the sense of empty sarcolemma tubes which may be extended in hourglass form	
Complete ruptures of the fibres, in some cases with disintegration of the sarcolemma and discoid curling of the torn ends	
Hypercontracted bands	
Homogenisation of the fibres	Indifferent (pre- and post-mortal)
Loss of cross striation	
Appearance of longitudinal striation	
Wave-like form of the muscle fibres	
Distractional and hypercontracted bands	
Block-like disintegration of the muscle fibres with retention of cross striation in the fragments	Areactive (post-mortal)
No discoid curling of the ruptured ends	
In places, convex intra-sarcolemmal ruptures with or without an empty sarcolemma	

bleed. Thus, further differential diagnostic deliberations had to be undertaken.

In the course of a typical hanging, one of the sequels of peracute anoxia with occlusion of the carotid arteries is the interruption of the perfusion of the respiratory centre; this causes a failure of the systemic rise in CO_2 as a factor in triggering respiration. For this reason, respiration is initially suppressed. Consciousness also fades after a few seconds [2, 5, 12]. However, heart activity is observed for considerably longer: agony durations of between 7 and 20 min (even longer in individual cases) have been described in cases of execution by hanging [6–9]. In cases of atypical hanging, signs of congestion in the head and neck region also result from the initial incomplete interruption of cranial arterial perfusion as the ligature interrupts venous drainage.

Furthermore, by analogy with death by drowning or obstructive asphyxia, in the course of death by hanging, phases of inspiratory dyspnoea or apnoea and terminal, sometimes convulsive, respiration exertions and hypoxic

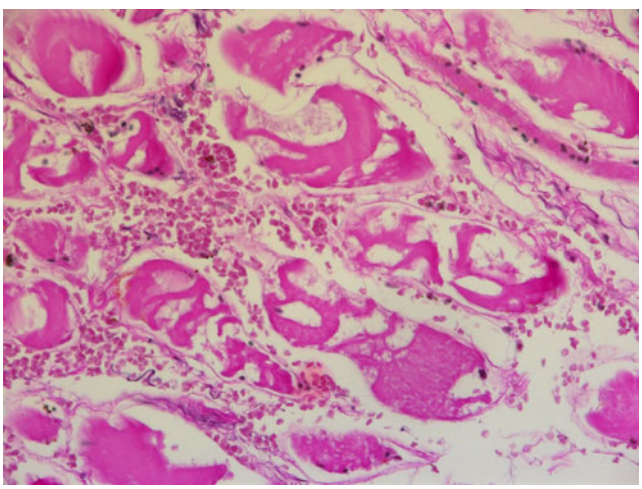

Fig. 3 "Vital" alteration to muscle fibres: distinct segmental and discoid forms of fibre disintegration, and concave, intra-sarcolemmal ruptures with an empty sarcolemma. Fresh haemorrhages nearby with no leukocytic reaction (musculus subscapularis). Elastic van Gieson staining, ×200

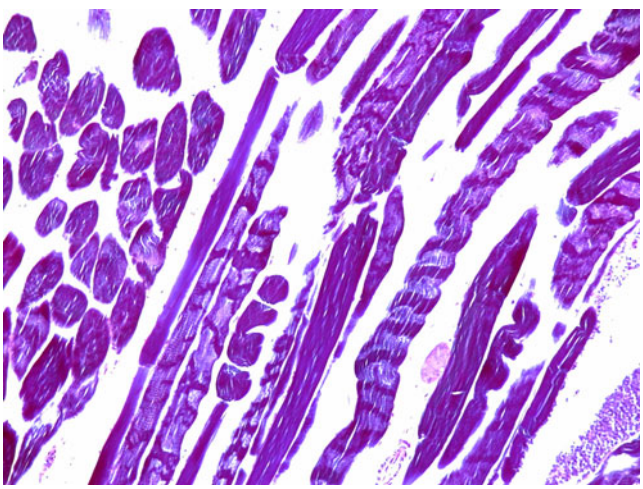

Fig. 4 Distinct hypercontraction bands, wave-like form of muscle fibres, and focally block-like fibre ruptures with replacement of cross striation by longitudinal striation. Adjacent fresh haemorrhages (musculus rhomboideus). Phosphotungstic acid haematoxylin staining, ×160

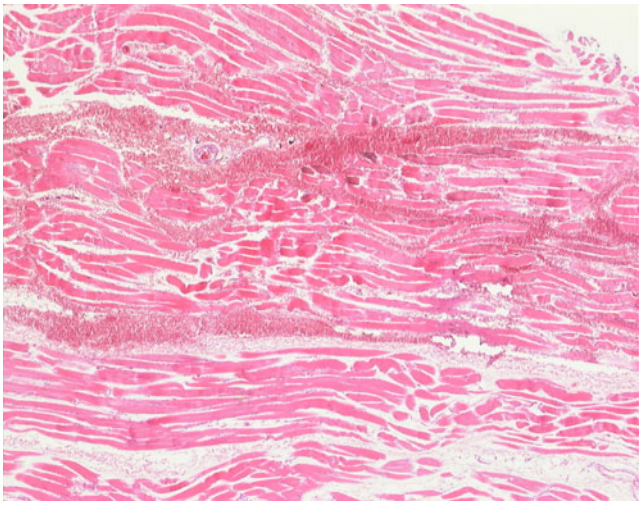

Fig. 5 Fresh communicating muscle haemorrhages with a hint of star-shaped configuration. Focally wave-like form of the muscle fibres, fibre ruptures (musculus infraspinatus). Haematoxylin–eosin staining, ×80

seizures occur [12, 42, 43]. In the event of (maximally) increased inspiration attempts, the so-called "auxiliary breathing muscles", in particular, are employed [51]. Although the topographical and anatomical definition of the respiratory and the auxiliary breathing muscles varies in clinical literature to some extent, there is a consensus that the muscle groups at the back of the body extending from the vertebral column to the upper extremity also move the ribs and sternum in the event of increased inspiration exertions and can thus be considered part of the auxiliary breathing muscles [52], whilst the autochthonous back muscles (musculus erector spinae) favour inspiration by means of reclination of the vertebral column. In the event of maximally increased inspiration and terminal convulsions of the thorax muscles, other muscle groups at the back of the body may also be used so that hyperextensions and hypercontractions of muscle fibres may occur there, causing the described scenario at autopsy of vital/agonal muscle haemorrhages without corresponding haemorrhages of the skin and/or subcutaneous fatty tissue [33–35]. In principle, it must be assumed that agonal respiratory distress leads to massive overload of the back and auxiliary breathing muscles with consecutive muscle fibre tearing. The spasmodic contractions may even affect the muscles of the arm region. Haemorrhaging into the muscles of the abdomen as an expression of maximally increased expiration attempts was not present in any of the cases, so an inspiratory event must be assumed in line with previously known pathophysiological processes.

In the present study, haemorrhages of the back and auxiliary breathing muscles—without corresponding haemorrhages of the skin and subcutaneous fat tissue—were found in approximately 30% of cases after death by hanging; the majority of these haemorrhages were classified histologically as pre-mortal (vital–agonal).

Although not being statistically significant, a connection may be deduced between the occurrence of haemorrhages of the back and auxiliary breathing muscles and the other parameters surveyed from our data for the median age: the difference ascertained—age in the group without haemorrhages with 43.5 years (± 16.6 SD) is 10 years lower than in the haemorrhage group with 53.5 years (± 12.0 SD)—could possibly be explained by the fact that at the higher age, due to, e.g. age-appropriate, arteriosclerotic-related degenerative changes in cerebral vessels, a lower level of hypoxia tolerance might exist in the sense of a decrease in the convulsion threshold, facilitating the occurrence of terminal hypoxic seizures and thus favouring the occurrence of haemorrhaging into the back and auxiliary breathing muscles. Altogether, statistical differences between both groups did not emerge, in particular, any correlation between the occurrence of muscle haemorrhages and body position, typical or atypical hanging or congestion syndrome.

It remains unclear whether the incidence of approximately 30% ascertained in our study corresponds to the actual occurrence of muscle haemorrhages in other populations of hanged persons. It is conceivable that such haemorrhages after death by hanging are possibly not ascertained at autopsy as the preparation of layers from the front and back side of the torso is not part of standard procedure during the post-mortem examination of hanged persons. In order to further validate the pathophysiological connections, we assume it will be necessary in future to systematically examine and evaluate cases of death by hanging with respect to intramuscular haemorrhages of the back and auxiliary breathing muscles in a larger population.

Conclusions of practical interest

Haemorrhaging into the back and auxiliary breathing muscles is evidently not uncommon during death by hanging. Evidence of such haemorrhages can be called upon as a further sign of vital hanging whilst considering differential diagnostic aspects, especially after histological preparation of relevant muscle sections and integration of all available information—under the assumption of underlying maximally increased agonal respiratory efforts and terminal hypoxic seizures.

Conflict of interest There is no conflict of interest. The corresponding author affirms that he has no relationships with a company whose product is mentioned in the article or with one that sells a competitive product. The presentation is impartial, and the content is independent of commercial influence.

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