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Original Article

CHRONICLES OF HEALING: UNVEILING THE SECRETS OF ABRASION AND LACERATION DATING IN FORENSIC PATHOLOGY

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ABSTRACT

Objective: In the field of forensic pathology, understanding the timeline of injury occurrence is of paramount importance. This study, titled "Chronicles of Healing: Unveiling the Secrets of Abrasion and Laceration Dating in Forensic Pathology," conducted a postmortem investigation to assess wound dating by gross and histopathological examination of blunt injuries.

Methods: A total of 195 case samples from 119 cases were scrutinized to establish the timing of various gross changes and microscopic alterations that transpire following blunt trauma. The study encompassed abrasions, contusions, and lacerations occurring within a time frame ranging from 0 h to a maximum of 45 d.

Results: The findings revealed that the gross changes in abrasions closely correlated with the corresponding microscopic changes, while contusions exhibited a similar correlation, except for a variation in the appearance of bluish color. In lacerations, the correlation was primarily evident during the early stages of injury.

Conclusion: Importantly, the study emphasized the substantial impact of comorbid conditions on the healing process, highlighting the need for cautious evaluation in such cases. The study concludes that naked eye examination alone is insufficient for precise injury dating, underscoring the importance of histopathological examination to ensure accurate conclusions regarding injury age.

Keywords: Gross changes, Histopathology, Dating of wounds

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INTRODUCTION

Wounds or injuries, the result of mechanical force applied to the body, are a pivotal concern in forensic pathology. These injuries come in various forms, ranging from abrasions and lacerations to contusions [1]. The assessment of such injuries encompasses a comprehensive analysis that delves into the type, location, size, pattern, and nature of the wound while also distinguishing between ante-mortem and post-mortem occurrences. Crucially, the precise determination of an injury's age takes center stage within the realm of medico-legal significance [2].

The dating of injuries carries immense weight not only in the field of forensic medicine but also in criminal investigations. It plays a pivotal role in either establishing the guilt or innocence of individuals charged with criminal acts. However, the process of dating injuries, particularly blunt force injuries, is a multifaceted endeavor that remains the subject of extensive research and debate [3]. The successful determination of an injury's age relies on various factors, including the anatomical region where it is located, the age of the individual affected, their medical status, the nature of the object responsible for the injury, and the duration of contact between the object and the body [4].

Blunt force injuries, characterized by their association with road traffic accidents, falls from heights, and assault, represent a substantial portion of cases encountered by forensic pathologists. These injuries encompass a spectrum of manifestations, with abrasions and lacerations being prominent among them. Accurately dating these injuries is a challenging and nuanced task, with substantial variations in the healing process influenced by a plethora of factors [5, 6].

In the subsequent sections of this article, we will delve into the intricacies of abrasions and lacerations, providing a comprehensive understanding of their gross and histopathological changes over time. While the gross features of these injuries offer initial insights into their age, it is through histological examination that a more accurate and precise dating of the injuries can be achieved [7]. These examinations are crucial in the realm of forensic medicine, as they aid in the administration of justice and play an essential role in determining the timing and circumstances of injuries in various cases, adding an indispensable layer of objectivity and accuracy to the medico-legal investigation process [8].

MATERIALS AND METHODS

The present study, conducted at the Department of Forensic Medicine and Toxicology, Dr. S. N. Medical College, and associated group of hospitals in Jodhpur from December 2017 to August 2018, aimed to determine the age of ante-mortem blunt injuries specifically for abrasions and lacerations. The inclusion and exclusion criteria for this part of the study were as follows:

Inclusion criteria

Cases where the time of infliction of the abrasion or laceration was known.

Exclusion criteria

Bodies in the state of decomposition.

Data collection and grouping

A standard proforma was employed to gather information concerning the time of injury, time of death, and any associated comorbidities. Consent for tissue sections was obtained through thorough interviews with investigating officers, relatives, or witnesses. The standard autopsy protocol was adhered to, which included recording the position, size, and color of injuries. The age of the injury was assessed based on these appearances and injuries were categorized into seven different time intervals: 0-4 h, 4-12 h, 12-24 h, 24-72 h, 4-6 d, 7-14 d, and more than 2 w old.

Histological examination

For the histological examination, microscopic evaluation was carried out to observe various changes in the abrasions and lacerations at different time intervals. These included:

Congestion/haemorrhage: Observed as early as 10 min.

Oedema formation: Seen within 15 min.

Margination of polymorph cells: Noticed around 30 min.

Early infiltration of neutrophil cells: Initiated at 6 h.

Predominant neutrophilic infiltration: Commenced at 12 h.

Mononuclear cell infiltration: Evident 24 h after the injury.

Fibroblast formation: Observed around 71 h.

Granulation tissue deposition: Occurring at 72 h.

Collagen formation: Apparent at 96 h (4 d).

Regression phase: Starting at 213 h (9 d).

RESULTS

The results of the study are presented in tables 1, 2, 3, and 4, providing a comprehensive overview of the distribution of abrasions by their gross changes and corresponding microscopic features over time.

Table 1 illustrates the distribution of abrasions based on their gross changes and the age of the injury. It categorizes abrasions into various stages, including bright red, reddish scab, brownish scab, dark brown scab, black scab, scab margin falling off, and scab fallen off completely. The table shows the number of cases within each category, providing a percentage breakdown.

Table 2 outlines the earliest, routine, and latest appearance of gross changes in abrasions. It indicates the time intervals at which different gross changes occur, starting with bright red and progressing through reddish scab, brownish scab, dark brown scab, black scab, scab margin falling off, and complete scab detachment.

Table 3 focuses on the histological changes observed in abrasions, providing information on the earliest and routine appearance of common microscopic features. These features include congestion/haemorrhage, oedema formation, margination of polymorph cells, early infiltration of neutrophil cells, predominant neutrophilic infiltration, mononuclear cell infiltration, fibroblast formation, granulation tissue deposition, collagen formation, and the regression phase.

Table 4 presents the correlation between gross changes and microscopic changes in abrasions based on the age of the injury. It scores the presence and intensity of microscopic features in relation to the age of the abrasion.

These tables offer a comprehensive overview of the study's findings, shedding light on the progression of abrasions and their corresponding histopathological changes over time.

Table 1: Distribution of abrasions by its gross changes wise

Age of injury	Gross changes							Total
	Bright red	Reddish scab	Brownish scab	Dark brown scab	Black scab	Scab margin Falling off	Scab fallen off completely	
	No.	No.	No.	No.	No.	No.	No.	No. (%)
0-4 h	26	0	0	0	0	0	0	26(28.26)
4-12 h	4	6	0	0	0	0	0	10(10.87)
12-24 h	0	7	2	0	0	0	0	9 (9.78)
24-72 h	0	7	9	1	0	0	0	17 (18.48)
4-6 d	0	0	4	2	1	0	0	7(7.61)
7-14 d	0	0	0	0	6	8	1	15 (16.30)
>2 w	0	0	0	0	2	4	2	8 (8.70)
Total	30	20	15	3	9	12	3	92 (100.0)

Table 2: Earliest, routine and latest appearance of gross changes of abrasions

Gross changes	Earliest appearance	Routine appearance	Latest appearance
Bright red	10 min.	0-4 h.	5 h.
Reddish scab	6 h.	12-24 h.	68 h.
Brownish scab	18 h.	24-72 h.	132 h.
Dark brown scab	44 h.	4-6 d	144 h.
Black scab	5 d	7-14 d	21 d
Scab fallen off at margin	6 d	7-14 d	15 d
Scab fallen off completely	11 d	>2weeks	17 d

Table 3: Earliest and routine appearance of common histologically detected changes of abrasions

Microscopic changes	Earliest appearance	Routine appearance
Congestion/haemorrhage	10 min.	0-4 h.
Oedema formation	15 min.	0-4 h.
Margination of polymorph cells	30 min.	0-4 h.
Early infiltration of neutrophil cells	6 h.	4-12 h.
Predominant neutrophilic infiltration	12 h.	12-24 h.
Mononuclear cell infiltration	24 h.	24-72 h.
Fibroblast formation	71 h.	71-78 h.
Granulation tissue deposition	72 h.	4-6 d
Collagen formation	96 h (4 d)	7-14 d
Regression phase	213 h (9 d)	>2 w

Table 4: Correlation of gross changes with microscopic changes of abrasions

Age of injury	Microscopic scoring											Total
	0	1	2	3	4	5	6	7	8	9	10	
	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No. (%)
0-4 h	21	1	4	0	0	0	0	0	0	0	0	26(28.26)
4-12 h	5	0	3	2	0	0	0	0	0	0	0	10(10.87)
12-24 h	1	0	0	1	7	0	0	0	0	0	0	9 (9.78)
24-72 h	0	0	0	0	7	5	1	4	0	0	0	17 (18.48)
4-6 d	0	0	0	0	0	0	1	5	1	0	0	7(7.61)
7-14 d	0	0	0	0	0	1	0	2	7	4	1	15 (16.30)
>2 w	0	0	0	0	0	0	0	1	1	5	1	8 (8.70)
Total	27	1	7	3	14	6	2	12	9	9	2	92 (100.0)

DISCUSSION

The study classifies abrasions based on their gross changes, age, and corresponding microscopic features. The findings revealed that abrasions demonstrated a progression of gross changes over time. Bright red abrasions were observed in the earliest stages, turning into reddish scabs, followed by brownish scabs, dark brown scabs, black scabs, scabs falling off at the margin, and eventually complete scab detachment. The earliest and routine appearance of these changes provided valuable insights into the timeline of abrasion healing [9].

Histologically, the study found that abrasions exhibit various microscopic changes over time. These changes included congestion/haemorrhage, oedema formation, margination of polymorph cells, early infiltration of neutrophil cells, predominant neutrophilic infiltration, mononuclear cell infiltration, fibroblast formation, granulation tissue deposition, collagen formation, and the regression phase. These histological changes correlated with the gross changes, providing a comprehensive understanding of how abrasions evolve over time [10].

Notably, the study's findings are consistent with previous research by Sharma A, Nandy A, Saukko P, and Dimaio V. J. They all reported similar observations regarding the timeline of abrasion healing and the histological changes associated with abrasions. This consistency in findings adds to the reliability of the study's conclusions [11].

Gross examination of lacerations revealed that the presence of hemorrhage or redness with swelling indicated an approximate age of 1 d. However, later changes in lacerations had a wider range, making gross appearances less consistent for dating the injury [12]. Histological examination of lacerations, on the other hand, provided more accurate timing of injury. It revealed the presence of haemorrhage and congestion of vessels in injuries of less than 14 h. Predominant neutrophil infiltration took around 8 h to occur, and mononuclear cell infiltration was observed in injuries at least one day old. Granulation tissue was seen after 4 d, and collagen tissue was visible after approximately 158 h (6½ days) [13].

The study underscores the importance of histological examination in confirming the age of injuries, as it offers a more accurate timeline for their occurrence, thus assisting in the administration of justice. While the study involved a relatively small number of cases, its observations were consistent with many similar studies, validating the credibility of the findings.

In comatose patients or those with comorbidities such as diabetes, hypertension, sepsis, malnutrition, etc., both gross and microscopic features appear to be delayed and inconsistent. This observation highlights the need for caution when determining the age of injuries in such cases [14].

CONCLUSION

In conclusion, this study significantly contributes to the literature on wound dating in forensic pathology. It sheds light on the progression of gross and histological changes in abrasions and lacerations over time, which can be instrumental in forensic investigations and legal proceedings. The findings emphasize the importance of histological examination in achieving more accurate dating of injuries, and they also acknowledge the potential delays and inconsistencies in comatose or medically complex patients.

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AUTHORS CONTRIBUTIONS

All authors have contributed equally

CONFLICT OF INTERESTS

Declared none

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