

Early Formation of Adipocere in Subtropical Climate

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Abstract—In this study, we have collected cases with adipocere formation, which were from the South Delhi region (average room temperature 27-39°C) and autopsied at our centre. Details of the circumstances of the death, cause and time of death, surrounding environment and demographic profile of the deceased were taken into account. Total 16 cases were included in this study. Adipocere formation was predominantly present over cheeks, shoulder, breast, flanks, buttocks, and thighs. Out of 16, 11 cases were found in a dry atmosphere, 5 cases were brought from the water. There were 5 cases in which adipocere formation was seen in less than 2 days, and among them, in 1 case, as early as one day. This study showed that adipocere formation can be seen as early as 1 day in a hot and humid environment.

Keywords—Adipocere, drowning, hanging, humid environment, strangulation, subtropical climate.

I. INTRODUCTION

ADIPOCERE formation is a modification of the process of putrefaction, where the body fat is hydrolyzed and hydrogenated to saturated fatty acids, in the presence of bacterial enzymes. This process requires presence of warmth, moisture, anaerobic environment and anaerobic bacteria. Presence of body fat and clothing also affect the process. Fresh Adipocere is soft, moist, whitish and translucent in appearance with rancid, while, old adipocere is dry, hard, cracked, yellowish and brittle [1], [2]. Adipocere is mainly comprised of saturated fatty acids, namely myristic acid, palmitic acid and stearic acids. However, unsaturated fatty acids, various salts of fatty acids and oxo- and hydroxo- fatty acids were also identified as constituents of adipocere. Adipocere formation is of much interest to forensic pathologists and forensic scientists, as it preserve the remain by inhibiting decomposition and also helps in determining time of death, if it is known how much time is needed for the formation of adipocere. The rate of formation of adipocere is modified by various factors, such as humidity and temperature of the environment, fat content of the body, presence/absence of clothing and bacterial activity [1], [2]. No precise time period can be stated however, in temperate climates, it takes weeks to develop, while in India, it starts to begin within 4 to 5 days [2]. No study has been done in this subtropical region to know the time duration for adipocere formation.

For this study, we have collected cases with adipocere formation in the year 2013 and 2014 so as to determine duration for formation of adipocere in this subtropical region.

II. MATERIAL AND METHODS

For this study, postmortem records of the cases with adipocere formation were analyzed. All the cases were from South Delhi region of India and were autopsied at our centre. Only those cases, in which the time of death was known, were included. Details of cause of death, the circumstances of death, surrounding environment where the body was found, and condition of the body was taken into account along with the demographic profile of the deceased. All the information was collected in a designed proforma. Adipocere formation in all the cases was diagnosed by gross examination by the authors themselves.

III. RESULT AND DISCUSSION

Total 21 cases with adipocere formation were found during the two year study period. Out of these, only 16 cases were included in this study, as 5 cases were not meeting our criteria about certainty of time of death (Table I). All the cases were seen during the month of May to October, when the weather is hot and humid. During these months average room temperature is 27-39°C with humidity between 20-90% [3].

All the deceased were healthy and died due to unnatural causes, except in 4 cases where cause of death was not determined at the time of autopsy but the death was sudden. All the cases were fully clothed at the time of death. Most of the cases were found in rooms without air conditioning. Only 5 cases were recovered from water sources or river bank. Extent of Adipocere formation was about same in all the cases recovered from rooms, irrespective of duration of recovery of the body of the deceased. The bodies recovered from the water sources showed more extensive distribution of adipocere formation (Table I).

In our series, there were five cases in which adipocere formation was seen in less than 2 days. First case was of ligature strangulation of 13 year old boy, where adipocere formation was seen in less than 1 day (Fig. 1). Body of the boy was recovered from a closed box inside a barber shop. Second case was of drowning of 55 year old male where it took 1 day and 4 hours for adipocere formation (Fig. 2). Third case was of a 59 year old female who died due to unknown cause. In the case, adipocere formation was seen in 1 day and 15 hours (Figs. 3 (a), (b)). Forth case was of a 47 year old alcoholic male who adipocere formation 1 day and 17 hours. He had died due to alcoholic intoxication (Fig. 4). Last case was of a 42 year old male who hanged himself. He had showed Adipocere formation in 1 day and 20 hours after the death (Figs. 5 (a), (b)).

Usually, adipocere formation is more frequently seen in females, well-nourished new born infants, obese and the body submerged in the water for a long period [2]. No such pattern

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is seen in this series. There were only 4 female cases out of 16 cases and were of age 5 years, 24 years, 29 years and 59 years. No case of infant with adipocere formation was seen during the study period.

S. L. Forbes et al. [4] had conducted a study on effect of burial environment on adipocere formation with pig adipose tissue. They pointed out that no external moisture is necessary for the formation of adipocere. However, presence of excess water enhances the rate of formation of adipocere. Our findings confirm their conclusions. Only 5 out of 16 cases were recovered from the water sources, rest of them were recovered from rooms, which suggests the fact that tissue water is sufficient for the process and external water is not needed. Only difference between the groups recovered from rooms and from water sources was that adipocere formation was more extensive in those cases which were recovered from water source.

Age-group ranged from 5 to 59 years in our study and as such, there is no correlation of age with duration or extent of adipocere formation. As such, the relation between the age

group and formation of adipocere is not well established in the literature.

Many studies have been conducted on the formation of adipocere, its chemical composition and various factors affecting formation of adipocere. Very few case reports have been published on such early formation of adipocere as in our study. Mohan Kumar TS et al [5] from India, reported a case of early adipocere formation within 3 days. J Simosen [6] reported a case of adipocere formation within 22 days in temperate climate during hot summer period. No experimental study has been done yet with human bodies to conclude rate of formation of adipocere. Rate of formation of adipocere is of vital importance if any clue about the time since death to be derived from it.

The findings of our study suggest that Adipocere formation is faster, as early as 1 day, in subtropical climates like ours and, in hot and humid weather. Presence of external water doesn't influence the rate of formation; however, it affects the extent of formation. With the presence of external water adipocere forms more extensively.

TABLE I
DETAILS OF THE CASES

Age (in years)	Sex	Month of Recovery	Duration since Death to Examination	Cause of Death	Extent of Adipocere Formation
42	Male	May'13	1 day & 20 hours	Hanging	Front & back of trunk, both upper limbs, except hands
35	Male	May'13	2 days & 7 hours	Undetermined ^a	Front of trunk, both upper limbs, except hands
59	Female	Jun'13	1 day & 15 hours	Undetermined ^a	Face, Front of trunk, both upper limbs, both lower limbs
5	Female	Jun'13	3 days & 5 hours	Drowning ^b	Face, Front & back of trunk, both upper limbs, both lower limbs
47	Male	Sep'13	1 day & 17 hours	Alcohol	Abdomen, both upper limbs, both lower limbs except feet
55	Male	Sep'13	1 day & 4 hours	Drowning ^b	Front & back of trunk, both upper limbs except hands, both lower limbs except feet
37	Male	Sep'13	3 days & 5 hours	Septicaemia due to burn	Front of trunk, sides of back, both arms
4	Male	Oct'13	2 days & 3 hours	Undetermined ^a	Front of trunk, both upper limbs except hands
38	Male	Oct'13	2 days & 9 hours	Drowning ^b	Abdomen, chest (not prominent), both arms (not prominent)
14	Male	Oct'13	1 week	Drowning ^b	Face, Front & back of trunk, both upper limbs except hands, both lower limbs except feet
33	Male	Oct'13	3 days & 3 hours	Head injury	Back of trunk, right upper limb except hand, front of right thigh
24	Female	May'14	6 days	Multiple stabs	Face, Front & back of trunk, both upper limbs, both lower limbs
35	Male	Jun'14	3 days	Drowning ^b	Front of trunk, both upper limbs except hands, front of both lower limbs except feet
13	Male	Jul'14	21 hours	Strangulation	Abdomen, lower part of back, left upper limb except hand
29	Female	Jul'14	3 days	Cut throat	Face, left side of trunk, lower part of back, both arms, both lower limbs
45	Male	Oct'14	6 days	Undetermined ^a	Front of trunk, left side of back of trunk, upper part of right thigh

^aCause of death remained undetermined at the time of autopsy.

^bCases recovered from the river bank.

IV. CONCLUSION

This study showed that the rate of formation of adipocere in subtropical climates is faster as the weather is hot and humid. This fact should be kept in mind while determining the time of death on the basis of formation of adipocere and its extent.

V. LIMITATION

This is a retrospective study where adipocere formation and its extent were determined by gross examination and small number of cases was included. A large scale experimental study is needed to confirm the findings.



Fig. 1 Body recovered within one day from indoor. Adipocere is present over lower part of back, left upper limb except hand



Fig. 2 Body recovered within 2 days from river bank. Adipocere is present over the front of the trunk, both upper limbs except hands, both lower limbs except feet



Fig. 1 (a) Body recovered within 2 days from indoor. Adipocere is present over face, front of the trunk, both upper limbs, both lower limbs



Fig. 3 (b) Back of the body of Fig. 3 (a): No adipocere formation



Fig. 4 Body recovered within 2 days from indoor. Adipocere is present over abdomen, both upper limbs, both lower limbs except feet



Fig. 5 (a) Body recovered within 2 days from indoor. Adipocere is present over the front of the trunk, both upper limbs, except hands



Fig. 5 (b) Back of the body of Fig. 5 (a): Adipocere is present over back

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