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Validation Study on the Embalming of Lynched Early Decomposing Bodies in Nigeria

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ABSTRACT

Background: When bodies are lynched, there could be loss of body parts, deep wounds, bruises and fractures of the bone which would lead to difficulties in embalming processes. There is little or no literature on the embalming of early decomposing lynched bodies in Nigeria. **Objective:** This study investigated the effectiveness of an embalming mixture containing formalin, methanol and water in preserving early decomposing lynched bodies using domestic pigs. **Materials and Methods:** Four domestic pigs were used to carry out this experiment. Early decomposition was noted within the first eight hours post mortem. Animals were embalmed via arterial and hypodermic embalming techniques. **Results:** Decomposition progressed to bloat and active decay stages at some body parts of the animals. Animals were re-embalmed at the 5th, 6th and 12th post mortem days via hypodermic embalming technique. However, decomposition was slowed down at the 7th post mortem day, and was completely halted at the 15th post mortem day. All the animals were completely fixed from the 15th day till the last day of the study period (35th post mortem day). **Conclusion:** An embalming fluid containing formalin, methanol and water is very effective in preserving lynched bodies by using the arterial and hypodermic embalming techniques.

Keywords: Embalming of decomposing bodies; Embalming of lynched victims; Mob justice; Modern embalming science; Mortuary science; Specialist embalming.

INTRODUCTION

Embalming is the process of chemically treating the dead human remains to reduce the presence of microorganisms, in order to halt decomposition, and restore its physical appearance.[1] It is also the process of preserving a body in order to prevent microbial activities, disinfect the body, prevent putrefaction so as to sanitize the environment.[2] Embalming is also required to prevent decomposition in order to prepare a body for burial or forensic examination or for long distance travel.[3] Over the years, different embalming chemicals and methods have been developed for the preservation of cadavers. In addition, the purpose of embalming also determines the choice of embalming chemical and

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method. [3-5] A well performed embalming can help preserve the body for many years.[3]

The aftermaths of the "ENDSARS PROTEST" in Nigeria led to increased crime rate, destruction of government properties and brutal killing of police personnel and civilians via lynching. Lynching is a premeditated extrajudicial killing by a group.[6] Lynched victims are tortured to death in more horrifying and gruesome ways by a group of individuals.[7] The lynching act leads to the distortion of anatomical structures of the deceased victims which eventually prevents the free flow of embalming fluid during embalmment.[8] When this occurs, lynched cadavers require special attention in order to halt decomposition as quick as possible. The difficulty in abating or slowing the rate of decomposition of lynched cadavers leads to decay which in turn increases the widespread of certain diseases.

The embalming of lynched bodies has also been a cause of concern to Nigerian morticians and Morbid Anatomists.[9] A study on the embalming of putrefying bodies in Anambra state has shown that lynched bodies require special attention.[2] This study identified different methods and mixtures predominantly used at the funeral homes in Anambra state and recommended a mixture of formalin, methanol, ammonium salt, thymol, dye and water using four-point, six-point, single point and hypodermic embalming methods for preserving putrefying bodies. However, this study did not identify the stage of decomposition and specific method suitable for embalming lynched bodies. Therefore, this study carried out a validity test to ascertain the effectiveness of an embalming mixture containing formalin, methanol and water on early decomposing lynched bodies using infant *Sus scrofa domestica*.

METHODS

Ethical consideration and approval for the study

The ethical approval was obtained from the ethical committee of the Faculty of Basic Medical Sciences, Nnamdi Azikiwe University, Nnewi campus, Anambra state, Nigeria. The certification number is NAU/CHS/NC/FBMS/OD/334 dated 28th July, 2021.

Materials

The materials used for the study include 40% formalin, 10% methanol, water, and four domestic pigs.

Location of the study

This study was carried out at the gross anatomy laboratory of the Department of Anatomy, Nnamdi Azikiwe University, Nnewi campus, Nigeria.

Experimental animals

The experimental animals used for the study were four (two males and two females) domestic pigs (*Sus scrofa domestica*) because of the ethical issues related to the mode of death of the animals. The animals were procured from a pig farm located very close to the study location. Animals were in healthy condition.

Experimental procedure

This study design was a single-case experimental study design. The concept used for the research procedure was formulated by the researchers. Data on the observable decomposition changes of the animals were collected by the researchers. The peri-mortem and post-mortem body temperatures of the pigs were documented.

Animals were sacrificed, and death confirmed when no heart beat was recorded using stethoscope and observation of the pupillary reflex. The exact time of death was recorded. Early visible signs of decomposition (algor mortis, rigor mortis, pallor mortis, livor mortis) were monitored for eight hours. After eight hours, the animals were embalmed via arterial embalming technique and was supplemented by hypodermic embalming technique.

The atmospheric temperature, humidity and room temperature were recorded from the time of death till the last day of the study. The post embalmment changes were monitored morning, afternoon and night for two weeks and subsequently monitored morning and night till the end of the study. The body

structures that were completely fixed where scored whereas the body parts not fixed were not scored.

Method of data collection for daily climate readings

The apparatus used to record the daily atmospheric temperature and humidity was Generic Neoteck digital indoor / outdoor thermo-hygrometer. The thermo-hygrometer was placed on the slabs of the dissecting room and the wire extended outside the room via its window. The time was set on the equipment to GMT (+1) to ensure accuracy in documenting the readings. The lowest atmospheric temperature of the day was recorded between 3am and 7am; and the highest atmospheric temperature of the day recorded between 11am and 3pm. The lowest humidity of the day was recorded between 11am and 3pm; and the highest humidity of the day recorded between 3am and 7am.

Method of embalming

The methanol, water and formaldehyde were measured using a measuring cylinder each 1000ml. Water was first measured, and this was followed by the measurement of formalin and methanol. Methanol was measured last because of its high evaporation property. Single point method of arterial embalming technique was first used via the internal carotid artery (on the neck); and was supplemented by hypodermic embalming technique in order to ensure that the embalming fluid circulated to all the body parts affected by the lynching process.

Scoring Method

This study developed a scoring method for the completely fixed parts of the carrions post-embalmment. The completely fixed parts were scored '1', whereas the unfixed parts were either scored '0' or not scored at all. The head and neck body structures that were scored are crown, two ears, two eyes, oral region, snout, dorsal aspect of the neck and ventral aspect of the neck. The body structures of the trunk that were scored are tail, umbilical region, thorax, dorsal aspect of the trunk and the anorectal region. The four limbs were scored individually.

Experimental control / precaution

Animals were procured from a farm close to the research facility in order to ensure that there was no change in body thermal condition. Animals were procured very early in the morning between 5am and 6am, and allowed to rest and acclimatize for a period of 1 hour before sacrifice. The study avoided parallax error when reading the animal weight on the analog weighing scale. The thermometer was cleaned with cotton wool and methylated spirit, and dried after every rectal reading to ensure accuracy in data collection.

Statistical analysis

The statistical tool used for this study was SPSS IBM series version 25. The data were descriptively and inferentially analyzed and represented in tables. Pearson correlation was used to test the relationship between outcome of embalmment (represented as body scores TBS) and embalming fluid (represented as volume of embalming fluid VEF). A regression model for the rate of change in body weight of the carrion with respect to embalmment was also derived.

Duration of research

This study lasted for a period of 35 days (from July 2020 to August 2020).

RESULTS

Body statistics of experimental animals

The peri-mortem body statistics of the animals showed that the animals were at adolescent age (three months old). The body temperatures were at optimal levels; and correlated with the ambient temperature. The post-mortem body statistics showed that all the animals were completely fixed with a significant decrease in body weight, chest and waist circumference. There was a slight decrease in recumbent length.

Visible post embalming changes

The visible changes within the first one hour after death are algor mortis, pallor mortis, livor mortis and rigor mortis (Table 1). The result also showed that flies were found at the orifices and open wounds

inflicted by the lynching materials (Figure 1). Subsequently the early post mortem activities progressed for eight hours till the animals were embalmed (Table 2). Despite embalming the animals, decomposition progressed to bloat stage up till the sixth day post mortem. The daily post embalming observations showed that decomposition activities began to slow down at the seventh day (Table 3; Figure 2). Decomposition gradually slowed down till the 15th day when it was completely halted. All the structures of all the animals were completely fixed and mummified with no putrid odour. There was no visible post mortem changes observed afterwards till the last day of the study (Table 4; Figure 3).

Figure 1: Day 1 Before embalming

Figure 2: Day 7 Post embalming changes

Figure 3: Day 35 Post embalming

Relationship between the outcome of embalming and independent variables

The dependent variable for this study is the outcome of embalming which was curated from the body scores of the animals; whereas the independent variables are the factors that influence post mortem interval which in turn could affect the outcome of embalming. The independent variables include room temperature, humidity, atmospheric temperature, volume of embalming fluid and duration of embalming.

Result from the Pearson correlation showed that there was a statistically significant weak negative correlation ($r = -.368$, $n = 35$, $p = .030$) between outcome of embalming and volume of embalming fluid; and a statistically significant very strong positive correlation ($r = .847$, $n = 35$, $p = .001$) between outcome of embalming and duration of embalming. Pearson correlation analysis showed a statistical insignificant correlation between outcome of embalming and atmospheric temperature ($r = -.115$, $n = 35$, $p = .512$), humidity ($r = .260$, $n = 35$, $p = .131$), and room temperature ($r = .092$, $n = 35$, $p = .600$) (Table 5).

Table 1: DAY 1 Data 10 Minutes periodic data after death

TIME	BT (^{0}C)	AT (^{0}C)	RT (^{0}C)	Visible Changes	Insect / Fly Activities
8:18	36.2	29.9	27.8	No pupillary reflex.	Nil.
8:28	35.9	32.5	29.3	Algor mortis starts.	Nil.
8:38	35.5	31.1	29.0	Body temperature drops.	Nil.
8:48	34.6	32.1	29.1	Body temperature drops with sipping out of blood and fluids from the oral cavity.	Houseflies at the oral region.
8:58	34.5	31.2	28.8	Pallor and livor mortises start.	Houseflies reach the head and neck regions.
9:08	34.2	31.4	29.0	Algor, pallor and livor mortises continue to progress.	Fly activities persist.
9:18	33.8	31.2	29.1	Rigor mortis started. Body temperature continue to drop. Lividity progresses as skin continue to turn pale.	Fly activities persist.

BT. Body temperature; AT. Atmospheric temperature; RT. Room temperature

Table 2: DAY 1 Data – Hourly Observation

Time	BT (^{0}C)	AT (^{0}C)	RT (^{0}C)	Visible Changes	Insect / Fly Activities
10:18	32.9	31.2	29.2	Algor, pallor, livor and rigor mortises progress.	Less fly activity.
11:18	32.5	33.4	29.4	Algor, pallor, livor and rigor mortises progress.	Less fly activity.
12:18	32.2	30.4	31.1	Increase in abdominal pressure with release of faecal matter from the anus.	Less fly activity.
1:18	32.2	31.2	30.7	Whitish foamy substance sips out of the oral cavity. Abdominal pressure increases.	Less fly activity.
2:18	32.0	33.2	31.7	Algor, rigor, pallor and livor mortises progress.	Fly activities increases around the ears, anal region and oral cavity.
3:18	31.1	28.2	32.0	Livor and pallor mortises became fixed.	Swarm of flies around the ear.
4:18	31.1	32.6	32.2	Algor, livor and pallor mortises became fixed. Rigor mortis continues to progress.	Swarm of flies around the ear.

BT. Body temperature; AT. Atmospheric temperature; RT. Room temperature

Table 3: DAY 7 Post -embalmment Visible Changes

Time	Head & Neck Visible changes	Trunk Visible changes	Limbs Visible changes
Morning (6 :16am)	Decomposition of the snout, crown, neck, oral region, ears, and eyelids gradually slowed down. There was no fluid discharge from the structures of the head.	Hair losses on the tail, umbilicus and anorectal region. However, decomposition of the trunk structures gradually slowed down with no-fly activity.	Decomposition of the forelimbs and hind limbs gradually slowed down with no-fly activity.
Afternoon (12:20pm)	Decomposition rate gradually slowed down.	Decomposition rate gradually slowed down.	Decomposition rate gradually slowed down.
Evening (6:02pm)	Decomposition rate gradually slowed down.	Decomposition rate gradually slowed down.	Decomposition rate gradually slowed down.

Table 4: DAY 35 Post -embalmment Visible Changes

Time	Head & Neck Visible changes	Trunk Visible changes	Limbs Visible changes
Morning (6 :00am)	All structures of the head and neck were completely fixed.	All structures of the trunk were completely fixed.	All the limbs were completely fixed.
Evening (6:25pm)	All structures of the head and neck were completely fixed.	All structures of the trunk were completely fixed.	All the limbs were completely fixed.

Table 5: Pearson Correlation between the outcome of embalmment and all the independent variables used for the study

		Duration of Embalming	Average Atmospheric Temp.	Average Humidity	Average Room temp.	Average Total Body Score	Average VEF
Average Total Body Score (Outcome of embalming)	Pearson Correlation	.847**	-.115	.260	.092	1	-.368*
	Sig. (2-tailed)	.000	.512	.131	.600		.030
	N	35	35	35	35	35	35

**. Correlation is significant at the .05 level (2-tailed).*
***. Correlation is significant at the .01 level (2-tailed).*

Key to Quality of Relationship
0.80 1.00 Very strong positive
0.60 0.79 Strong Positive
0.40 0.59 Moderate positive
0.20 0.39 Weak positive
0.00 0.19 Very weak positive

DISCUSSION

The body statistics of the animals were similar and the body temperatures were at optimal levels with the ambient temperature. The significant decrease in body statistics and the dryness of the animals (at the last day of the study), are visible evidences that the animals were completely fixed; and this denotes a high-level potency of the embalming mixture (methanol, formaldehyde and water) and the techniques (arterial and hypodermic embalming) used in this study. This correlates with the report by Richins *et al.* which noted that formaldehyde is an excellent tissue fixative associated with extreme rigidity and dryness of a cadaver preventing bacterial, fungal and insecticidal activities.[10] In addition, Bradbury and Hoshino reported that a mixture containing methanol prevents the polymerization of formaldehyde, and aids in establishing the proper density of the solution.[11]

However, it was observed that regardless of the embalming process carried out after eight hours on the animals, decomposition progressed to the bloat and active decay stages in some of the body parts. This is because, the mode of death distorted the anatomical structure of the animals thereby preventing and / or slowing the free flow of embalming fluid all over the body of all the animals. Recall that several authors have listed lynched bodies to pose a challenge for embalmers, and that it requires special attention. [9,12,13] Therefore, there was a need to re-embalm the areas that embalming fluid did not properly circulate to. This was achieved via hypodermic embalming method. This approach correlates with report by Onyejike *et al* and Mayer. [2,13] The outcome of the embalming process was statistically affected by the volume of embalming fluid. This means that the embalming mixture is very reliable. The constituents of this mixture have a strong preservative effect on putrefying bodies as reported by several authors. [2,3,9] Factors of decomposition such as humidity, room temperature, atmospheric temperature did not statistically influence the outcome of the embalmment. This could be because; the climatic factors were at optimal levels and not at extreme levels.

CONCLUSION

An embalming mixture containing methanol, formalin and water (in equal proportion) can halt early decomposing lynched carcass. Embalming of lynched animals requires a close observation and attention. Arterial embalming technique should be supplemented by hypodermic embalming technique in order to achieve a good embalming result for decomposing lynched carcasses. Climatic factors do not influence the outcome of embalming lynched carcasses.

Author contributions

This work was carried out in collaboration of all authors; and all authors read and approved the final manuscript. Author ADC supervised the experiment, revised the manuscript, and edited the final draft of the manuscript. Author ODN conceptualized the study, designed the study, carried out the experiment and wrote the first draft of the manuscript. Author OIF curated the data. Author OIM managed the literature searches. Author OIJ wrote the experimental protocol. Author OEA acquired and managed the animals. Author OGC assisted author OIF to curate the data. Author EEN assisted author OIM to manage the literature searches. Author AAE assisted author OIM to manage the literature searches. Author OSN assisted author ADC to review the draft manuscript.

Data availability: The data used to support the findings of this study are available from the site publicly.

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