Post mortem fetal extrusion: Analysis of a coffin birth case from an Early Medieval cemetery along the Via Francigena in Tuscany (Italy)

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A R T I C L E I N F O

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A B S T R A C T

Death was a common factor during pregnancy and childbirth in both past and recent societies. Nevertheless, the recording of women from archaeological contexts still featuring a fetus in the pelvic cavity or dystocia is very rare. Even less frequent are cases of post mortem fetal extrusion.

At the archaeological site of San Genesio (San Miniato, Pisa), a stoppage point along the Via Francigena, the cemetery phases dating from the 6th to the 13th century were investigated. In one of the phases dating to the Early Medieval period, the skeleton of a female individual of about thirty years of age, deceased during the 32nd week of pregnancy, was documented. The fetus was positioned between the femurs, in the opposite orientation to that of the mother. Taphonomic analysis, comparative review of other forensic and archaeological cases and the anthropological study of the recorded skeletons suggest that, due to the accumulation of gas during the emphysematous phase of decomposition, the fetus would have been expelled from the mother’s pelvic cavity before the bodies were completely covered by soil. We can define this finding as one of those rare cases of “coffin birth” in an archaeological context.

1. Introduction

The high rate of female mortality in ancient times is generally related to pregnancy difficulties, complications during childbirth or breastfeeding (Wells et al., 1975; Molleson, 1986; Arriaza et al., 1988; Campillo, 1995; Šlaus, 2000). In the Middle Ages maternal mortality may have been the cause of death for a high percentage of young women (Högberg et al., 1987) and is still today related to the death of 30–40% of women in developing countries (Wilmot and Gemmill, 2012). However, little has been written about female fertility and maternal mortality from an archaeological perspective; in most cases, this connection has been established by way of indirect surveys, such as paleodemographic data and ethnographic references. Direct evidence in archaeological contexts, i.e. the finding of women with fetus still present in the pelvic cavity (Wells et al., 1975; Campillo, 1995; Lewis, 2007; Mongelli et al., 2008; Sayer and Dickinson, 2013) or cases of obstetrical complications, such as dystocia, are rare (Malgosa et al., 2004; Cruz and Codinha, 2010; Lieverse et al., 2015). Even less frequent are examples of post mortem fetal extrusion (Augias et al., 2015).

The reasons for this apparent contradiction, i.e. high maternal and fetal mortality in Antiquity and scarcity of evidence, are varied. On the one hand, causes may be traced back to field operations: burials are in many cases are not excavated by anthropologists, at times confusing fetus bones with microfauna remains or overlooking them completely (in Italy it is not mandatory to have anthropologists during the excavation of human remains); on the other, taphonomic factors and the fragility of these osteological remains can lead to their full loss (Guy et al., 2019; Lewis, 2007). Archaeological ‘invisibility’ can also arise from contingent causes: mother and child must have died together so that the woman may be buried along with the fetus, in utero or partially born, so as to be documented in the archeological record (Lieverse et al., 2015). Lastly, in certain periods, causes may be cultural: the Lex Caesarea, documented from the 7th century BCE, required the fetus to be extracted from the womb of the mother who died during labour (Hillan, 1991; Fadel, 2011).

In this work a detailed study was carried out on a possible case of post mortem fetal extrusion recorded from an Early Medieval cemetery phase at the archaeological site of San Genesio (San Miniato, Pisa), whose interpretation stems from a comparative analysis of anthropological, taphonomic and forensic evidence.
2. Archaeological context

The archaeological site of San Genesio is located between Pisa and Florence, along the Via Francigena (Fig. 1). Fieldwork activities have allowed to record the development phases – ranging from 6th to 13th centuries AD – of one of Tuscany’s most important religious centers along with its cemeterial area. The stratigraphic sequence shows that the area in question had seen occupation since the 3rd century BCE. During the Roman centuriation of the Valdarno area, a structure interpretable as a mansio was erected (possibly the one referred to as In portu in the tabula Peutingeriana and located along the road connecting Pisa to Florence) and abandoned in the first half of the 6th century, a period coinciding with the Gothic war that ravaged the Italian peninsula for almost two decades (535–554 CE). The second half of the century saw the establishment of an extensive burial area, the oldest cemetery phase recorded at the site. A stone tower was built in the first half of the 7th century, around which a series of structures in perishable material were arranged, abandoned in the second half of the same century when the center started to take on the form of an organized village with houses and fields, namely the vicus Wallari mentioned in the written sources from 715 CE. By the end of the 7th century the village will also feature a church dedicated to San Genesio, remembered from the second half of the 8th century onwards as a parish church. A large cemetery encloses the religious structure, seeing continuous use up until the middle of the 13th century, although with changes in its topographical layout. Next to the church, the centre of a curtais of the Marquis of Tuscia Adalbert will be set up in the course of the 9th century, furnished with olive presses, grindstones and a pottery kiln. At the start of the 10th century the ancient parish church will be rebuilt in the form of a large three-nave basilica (Fig. 2). At the same time, the village of San Genesio will become an important stoppage point (submansio) along the Via Francigena, mentioned by Archbishop Sigeric in his pilgrimage from Rome to Canterbury around 990 CE. The village, known from the 10th century as burgus of San Genesio, developed in economic and urbanistic terms between the 11th and 12th centuries. According to written sources the village was destroyed by the nearby castle of San Miniato in 1248 CE (Cantini, 2008; Cantini and Salvestrini, 2010; Cantini, 2012; Cantini and Viva, 2018; Cantini et al., 2019).

Over 400 burials have been excavated (including those discussed in this paper) ascribable to four major chronological periods. The study of the cemetery phases have taken into account burial type, orientation, the presence of grave goods as well as taphonomic aspects such as decomposition in covered or empty space, while anthropological analysis considered sex, age and state of health of the individual at the time of death (Viva, 2017; Cantini and Viva, 2018; Cantini et al., 2017).

3. Materials and methods

The skeletons object of this study (SK254 and SK258) were recorded in an Early Medieval cemetery phase from the archaeological site of San Genesio. The burial took place between the end of the 9th – beginning of the 10th century (Viva, 2017). The two individuals were buried in an earthen grave with a headstone set at the foot of the adult.

Taphonomic observations, essential for the interpretation of the funerary complex, have been carried out with reference to previous studies (Duday et al., 1990; Duday, 2006; Fabbri et al., 2006; Mallegni and Rubini, 1994; Mallegni, 2005) and have focused on skeleton position, if primary or secondary, anatomical connection, type of decomposition, if in full or empty space. The anthropological study was carried out on a sample of 257 individuals from different chronological phases (Viva, 2017), although presently illustrated methods refer only to the two examined skeletons. Sex determination for the adult was defined using the DSP method (Diagnose Sexuelle Probabiliste; Murail et al., 2005), i.e. by probabilistic analysis on pelvic bones. The adult age at death was estimated by the remodeling of the pubic symphysis (Todd, 1921; Brooks and Suchey, 1990), the auricular surface of the ileum (Buckberry and Chamberlain, 2002) and the apposition of canine secondary dentine (Cameriere et al., 2009).

The fetal age at death was estimated from basiocciput measurement (Tocheri and Molto, 2002) and length of the petrous rock (Nagaoka and Kawakubo, 2015).

4. Results

4.1. Taphonomic analysis

The burial in which SK254 and SK258 were documented was narrow in the mid-lateral direction, as evidenced by the wall effect observed on both humeri of the adult, which were in lateral view. Observations noted during excavation confirmed that the burial, containing the remains of two skeletons apparently deposited at the same time, had not seen posthumous violation. The skeleton of the woman...
rested in dorsal decubitus, with upper and lower limbs stretched out and parallel to the median sagittal plane, with a south-north orientation, the skull pointing southward. Primary position was established on the basis of anatomical connection, in particular of the skeletal districts characterized by labile joints. The fetus was in a consistent anatomical position, oriented in the opposite direction to that of the adult (north–south) and between its femurs; distal ends of the fetus lower limbs were in contact with the ischiopubic branches of the adult (Fig. 3).

As to type of decomposition, only a few of the right hand phalanges had fallen out of the corpse volume. However, the presence of a headstone – characteristic of this earthen burial type – suggests that this acted as support for a perishable material cover, such as a wooden board or plank, an hypothesis confirmed by the high percentage of taphonomic aspects typical of decomposition in empty space recorded from the same archaeological context (94.6%; Viva, 2017) as well as in other coeval sites (75.0%; Viva, 2020). The almost perfect state of anatomical connections must not be misleading. The excavation area is in fact marked by the presence of a particularly fine sediment, filtering inside the burials in a very short time span before complete skeletonization took place. For this very reason significant bone movements are not recorded inside the tomb. Furthermore, in this specific case, the very narrowness of the pit further prevented movements outside the original corpse volume.

Fig. 2. The parish church of San Genesio and part of the cemetery.

Fig. 3. The burial of SK254. On the right, in the yellow oval, the fetus (SK258).
4.2. Anthropological analysis

The adult skeleton belonged to a female individual who died at about 30 years of age (stage V: 27–30, Todd, 1921; stage 3: 30.7, Brooks and Suchey, 1990; stage II: 29.33 Buckberry and Chamberlain, 2002; 29.5 Cameriere et al., 2009). Regarding the fetus, there is agreement between the two methods used of the occipital base and petrous rock resulting in an estimated age of 32 weeks (Fig. 4).

The skeletons show no macroscopic evidence of pathology.

5. Discussion

An unusual double burial was recorded at the archaeological site of San Genesio, consisting of a fully preserved skeleton of an adult female of about 30 years of age, together with a fetus in an unusual position: outside the pelvic area, between the femurs of the mother and with an orientation opposite to hers.

Bisome burials are rare at San Genesio, with only one case of two sub-adults buried together (0.2%; 1/420; Viva, 2017).

To interpret this case we have referred to the forensic and archaeological scientific literature, especially to the general guidelines when an archaeologist is assessing the placement of the fetus and the adult (Lewis 2007): if the fetal remains are complete and in a position inferior to and in-line with the pelvic outlet, with the head oriented opposite to that of the mother (toward the foot of the grave), then there is the high possibility of coffin birth (Lewis 2007; O’Donovan et al. 2009); evidence for postmortem fetal extrusion are when the fetal remains are found to lie within or in contact with the pelvic outlet of the adult, thus indicating that partial or total extrusion had occurred during decomposition (Hawkes and Wells 1975). In our case, the fetal foot bones were in close contact with the adult’s pelvic bones. If a perinate is found buried alongside an adult or in his arms, with the same head orientation, then the infant has been buried post-birth, whether naturally or by caesarian section (Lewis 2007). This custom is widespread and well documented by archaeological cases in many cultures from prehistory to the modern age (Price and Petersen, 1987; Halcrow et al., 2008; Čechura, 2018; RAA, 2018). For this reason we have also discarded the hypothesis of late miscarriage which cannot be proven and seems unlikely: the position of the fetus does not seem compatible with a voluntary deposition.

Therefore, everything suggests that our case is not an intentional burial, but that the woman died during pregnancy and not following childbirth.

The unusual position of the fetus, the opposite orientation to that of the mother and the non term pregnancy, but at 32 weeks of gestation, suggests that it is a case of “coffin birth”, i.e. a process of post mortem fetal extrusion. This phenomenon, which involves the expulsion of a non-living fetus from the body of the mother who died during pregnancy, has been documented both in the forensic (Panning, 1941; Schulz et al., 2005; Lasso et al., 2009) and archaeological fields (Rascón Pérez et al., 2007; Sublimi Saponeetti et al., 2013; Appleby et al., 2014; Cesana et al., 2017; Pasini et al., 2018). In addition, it seems to mainly involve preterm fetuses, therefore relatively small, and with cephalic presentation (Schulz et al., 2005; Rascón Pérez et al., 2007; Lasso et al., 2009; Appleby et al., 2014). According to several studies, immature fetuses are more easily and effectively expelled from the progressive pneumatical pressure produced by putrefactive gases (Schulz et al., 2005): in the cases mentioned the fetal age was between 28 and 35 weeks of gestation. What happened to SK254? Post mortem fetal extrusion can be very difficult to recognize when a body has undergone complete skeletonization, which is why one must be cautious as to the occurrence of this phenomenon. Thanks to an anthropological, taphonomic and forensic approach, it has been possible to reconstruct how and through which passages it was possible to assume the coffin birth phenomenon (Augias et al., 2015), excluding and/or accepting some reconstructive hypotheses. First, the woman died before the term of the gestation, then both died during pregnancy or during a premature birth. It has been established that the only way to identify death by childbirth is direct association, i.e. when the fetus is found in the pelvic canal (Wells, 1978). We have excluded a case of dystocia: if death had occurred following labor, the fetus would in all probability not have been placed in that unusual position, between the femurs of the mother, with opposite orientation to hers. Although most of the double burials with recorded fetus were associated with labor-related complications (Sayer and Dickinson, 2013; Augias et al., 2015), in our case, there is no evidence that the death was due to obstetrical difficulties. The cause of death of the woman left no trace on the skeleton: we can only assume that, at the time of death and burial, the fetus was in utero. The find position, with opposite orientation to that of the mother, confirms the cephalic state during pregnancy.

The appearance of the emphysematous stage of decomposition, in temperate climate, like the one in Central Italy, and in closed spaces, like a tomb, appears in summer within 3–6 days and in winter within 3–6 weeks (Cattaneo and Grandi, 2004) and persists for 5–7 weeks (Bass and Jefferson, 2003). During this phase, due to the formation of gas as a result of anaerobic germs, the corpse swells up (Clark et al., 2006) and in our case would have reached a volume and pressure such as to make possible the expulsion of the fetus (Augias et al., 2015). It was also considered that post mortem fetal extrusion must take place between 48 and 72 h after death (Smith, 1955), otherwise the onset of fetal decomposition would have hindered expulsion. So one of the preconditions for this discovery is that death occurred at a hot time of year.

From a taphonomic point of view, it is possible to compare this case with other similar archaeological findings. In many cases, where the anatomical position of the fetus is anatomically correct, it was oriented in the opposite direction to that of the mother. In the medieval Muslim necropolis of Baza (Granada, Spain) (Rascón Pérez et al., 2007), the mother was in right lateral decubitus and the fetus rested on the medial...
part of the right femur, partly covered by the left femur. In a Roman tomb from Conversano (Bari) (Sublimi Saponetti et al., 2013) the mother’s skeleton was in dorsal decubitus, but with the lower limbs flexed and bent to the right, consequently the fetus had part of the skull and trunk covered by the left femur of the woman. The Modern Age discovery of the cemetery of Le Morne (Mauritius) (Appleby et al., 2014) is the one that most closely resembles the case of San Genesio: the mother’s skeleton was in dorsal decubitus with the lower limbs outstretched; the fetus was between the mother’s femurs, even if in a more distal position, therefore further away from the woman’s pelvis. In all the examples cited, decomposition had occurred in empty space. On the other hand, in a pit with earthen infill it is highly unlikely that a delivery will occur, seeing that the sediment adheres to the corpse, surrounding both the abdominal and pelvic areas along with the lower limbs (Sayer and Dickinson, 2013). Therefore, in the present case, the pit would have been progressively filled after fetal expulsion, which, as seen, occurs shortly after death and before the beginning of corpse skeletonization. Post mortem fetal extrusion is further evidence of decomposition in empty space.

6. Conclusion

Coffin birth is uncommon in the archaeological record. The case presented in this paper was documented in an Early Medieval cemetery developing around an important religious centre located along the Via Francigena. This consists of a post mortem fetal extrusion, a rare finding in osteoarchaeology, for which, thanks to a multidisciplinary approach involving archaeology, anthropology, taphonomy and forensic science, it was possible to put forward a plausible interpretable reconstruction. The discovery is exceptional because of the combination of different circumstances for post-mortem fetal extrusion to occur: 1) premature fetus, therefore small size; 2) cephalic presentation; 3) death occurring in a sufficiently warm period of the year; 4) empty space burial. The present research can be a valuable archaeological testimony of the phenomenon and confirmation of the necessary ways for this to happen.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Author Contributions

SV and PFF conceived the study. SV and PFF performed analysed data. SV and FC assembled archaeological materials and provided information for the study. SV wrote the manuscript with input from all co-authors.

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