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Two findings of gallstones in archaeological mummies from Colombia

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ABSTRACT

Results involving the analysis of gallstones found in two pre-Hispanic Colombian mummies are presented. By applying SEM, X-ray diffraction (XRD), sectioning, and CT-scan Hounsfield Units, we were able to identify these choleliths as mainly formed by cholesterol. The number of reports on gallstones in archaeological human remains from South America is very small, making these two cases an important addition to what little is known about ancient gallstone disease on the continent.

1. Introduction

Gallstones are a common occurrence in human populations, although they are often asymptomatic. Indeed, statistics on the formation and presence of gallstones were initially based on autopsies (Steinbock, 1990: 99), although today's modern imaging technology has changed that considerably (Shaffer, 2005: 133). Large stones, or those interfering with the normal flow of bile from the liver or the gallbladder, can give rise to clinical problems. Pain produced by stones lodged in the cystic duct is said to be among the most severe a person can experience, caused by pressure on the contracting bladder from the stones and retained bile, which is unable to leave the bladder. If the stone blocks the common bile duct interrupting the flow of bile into the small intestine, jaundice—a yellowing of the skin due to hyperbilirubinemia, or excess bilirubin in the blood—is produced. A number of studies in modern populations around the world show that gallstones are almost universally present, but their prevalence varies geographically, suggesting genetic, alimentary, and/or environmental causes for such variation (Everhart et al., 1999; Qiao et al., 2013). Studies also show that, although both men and women suffer from this disorder, women are more prone. Worldwide, modern statistics indicate that the ratio of gallstones in women to men is nearly 2:1 (Angarita et al., 2010: 302), due mostly to the action of estrogen that increases the amount of cholesterol in the body, especially during pregnancy. Some populations, such as the Pima American Indians, Chileans, and the Swedes, have a high incidence of gallstones, whereas this incidence is low among the Japanese and other Asiatic peoples and rarely seen in some African societies (Sampliner et al., 1970; Miquel et al., 1998; Angarita et al., 2010; Tiderington et al., 2016). Evidently, the etiology of gallstones is multifactorial and has become more complex in the modern world, with a growing number of man-made factors that may play a role in their formation. Thus, the specific causes for the presence of choleliths in ancient populations are far from clear, and difficult to ascertain.

Man has known jaundice and gallstones since antiquity. From Ancient Egypt, Persia, Greece, and China (Glenn, 1971; Wei, 1973; Cheng, 1984; Cesarani et al., 2009) to Western Europe and the Americas, diseases of the gallbladder and liver have been documented in written records since the times of Hippocrates (Steinbock, 1990: 100), and probably earlier in Egypt, with the unconfirmed possibility that inflammation of the gallbladder or the appendix was already described in the Ebers Medical Papyrus—a document dating to around 1500 BCE (Rowling, 1967: 493). During careful archaeological excavations of human skeletal remains, Angel (1973) found gallstones in Mycenae (Greece), and Lovejoy (personal communication to Steinbock, 1990: 104) found six cases in a large cemetery in Ohio pertaining to the Libben culture. Two important historical paleopathological studies of biliary tract disease are those by Glenn (1971)—a very complete discussion that presents several ancient cases of stones—and by Steinbock (1990), who published a detailed and complete analysis of archaeological gallstones, presenting a classification of each known type based on their content and appearance in cross section and their process of formation. He suggests four types of gallstones: cholesterol, mixed, combined, and pigment (op cit., p. 96). Steinbock's work also provides an illustrative historical and chronological sequence of the places where gallstones have been found and the authors who studied them. Aufderheide and Rodríguez-Martín (1998) offer an excellent explanation of gallstone etiology and mention findings of ancient gallstones in Greece, Egypt, China, Italy, Chile, Colombia, and the United States.

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However, the number of gallstones that have been recovered by archaeological excavations is scant, often because they are easily overlooked during excavation or mistaken for stones of geological origin. In this respect, mummies can be an important source of information for studying gallbladder disease in antiquity. In mummies that are well preserved and not eviscerated, gallstones can generally be found in good enough condition to allow the application of modern analytical techniques to their study. We refer our readers to the abovementioned references for a general historical background of gallstones in paleopathology.

In South America specifically, evidence for gallstones in archaeological contexts, including mummified remains, is meager, with just a few reported cases in the literature. Munizaga et al. (1978) report two cases of gallstones in two Chilean mummies from the coastal desert area of Tarapacá, one in an adult female and one in an adult male. These two specimens were part of a group of 75 mummies excavated in that archaeological area of northern Chile and represent 2.6% of the sample population available to the authors for study. The approximate date of those two specimens is given as "…the second to third century A.D." (op. cit., p. 210), that is, 100–200 A.D. Subsequently, Aufderheide and Rodríguez-Martín (1998: 272) reported a large gallstone made up of many smaller, faceted dark brown stones found in a Chinchorro mummy from northern Chile with a relative date of 2000 B.C.[1] Finally, Cárdenas-Arroyo (1998: 207) showed a CT image of the gallstone found in Mummy #1 that we analyze in detail here. Including the two gallstones in the present study, the number of archaeological gallstones reported for South America in the scientific literature to this day is only five.

2. Materials and methods

2.1. Description of materials and radiocarbon dating

The gallstones were detected in two pre-Hispanic mummies from Colombia (South America) belonging to the collection of the Colombian Institute of Anthropology and History.[2] Mummy #1 (38-I-777) (Fig. 1) has been part of the collection of the National Museum of Colombia since as early as the second quarter of the 19th century (Zerda, 1882) and, although its exact place of origin is unknown, it very likely comes from the central highlands of Cundinamarca or Boyacá, regions that were occupied by agricultural chiefdoms at the time when this individual was alive. Radiocarbon dating was done at the Oxford Radiocarbon Accelerator Unit (sample OxA-2816), giving a radiocarbon date of 710 ± 60 BP (or 1240 A.D., not calibrated). The $\delta^{13}C$ value of –11.0 for total diet in this individual suggests a diet based on C4 plants, which in this part of the world we interpret as primarily maize. Pollen remains of maize found in the stomach confirm that this person consumed this grain and charred foodstuff. Biological age at death was estimated using the degree of closure of long bone epiphyses as seen on conventional X-rays, the state of eruption and development of teeth, and their degree of occlusal surface wear, using international standards of measurement (Buikstra and Ubelaker, 1994). Eruption of the third molars and evidence of some antemortem mandibular tooth loss with complete bone reabsorption lead us to estimate a biological age at death of at least 30+ years. Macroscopic sex estimation was difficult due to the sitting position of the body and flexed legs, as well as the various creases formed by dry external tissues that can mimic dried breasts and genitalia. However, ancient DNA gender analysis on a soft tissue sample

Fig. 1. Mummy #1.

conducted at the British Columbia Institute of Technology (BCIT), Canada, showed a female profile (Monsalve, M.V., 2017 personal communication). Visible cultural alterations on this body include a slight artificial AP cranial deformation achieved by bandaging that produced a considerably flattened frontal bone and bulging parietal eminences. The face has brownish-red paint that seems more splashed-on than carefully applied, and there is a small fiber anklet around the left lower leg.

Mummy #2 (42-IX-3956), (Fig. 2) was purchased in 1942 by the Instituto Etnológico Nacional.[3] As stated in the Institute's registry, this mummy was purchased from Mr. Mario Yepes and was found in the environs of the town of Chiscas, an area where a number of archaeological mummies were found in the 1940s. The town is located in the highlands of the Department of Boyacá, again occupied by agricultural chiefdoms of the Lache Indians when this individual was alive. Radiocarbon dating was done at the Oxford Radiocarbon Accelerator Unit (sample OxA-2829), giving a radiocarbon date of 1480 ± 100 BP (or 470 CE, not calibrated). The $\delta^{13}C$ value of –14.5 for total diet suggests a tendency towards a diet based on C4 plants. Biological age at death was estimated using the degree of closure of the long bones epiphyses as seen on conventional X-rays and CT scans, and direct observation of the state of eruption and development of teeth and their degree of occlusal surface wear, using international standards of measurement (Buikstra and Ubelaker, 1994). All third molars seem to be congenitally absent in this individual, with antemortem loss of both left mandibular molars probably due to infection, and extensive maxillary postmortem tooth loss. We estimate a biological age of 25+ years at time of death. Sex

[1] This case was presented at the 59th Annual Meeting of the Society for American Archaeology in 1994 (A.C. Aufderheide and M. Allison). To our knowledge, this work remained unpublished.

[2] Both specimens are presently curated at the Physical Anthropology Laboratory of the Universidad Nacional de Colombia, Bogotá. Accession Numbers are Icanh 38-I-777 (Mummy #1), and Icanh 42-IX-3956 (Mummy #2)

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