J. Biol. Res. 2005 n.1 - Vol. LXXX - Rubbettino - Soveria Mannelli

The Prince of el Plomo: New Studies 50 Years After its Discovery

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KEY WORDS: freeze dried body, paleopathology, computerized imaging, hair analysis, molecular ABO blood group determination

Introduction

Within the past 50 years, several mummies have been found in the Andean region of South America at altitudes between 5.200 and 6.700 meters above sea level. All of these human remains belong to the Inca civilization and date from approximately 1.475 A.D. to 1.540 A.D. (Horne, 1996). In 1954 the first of these corpses, a well preserved freeze dried body of an eight-to-nine-year-old Inca prince (Fig. 1), was discovered at 5.400 meters on Cerro El Plomo, a mountain peak some 45 km. east of Santiago,

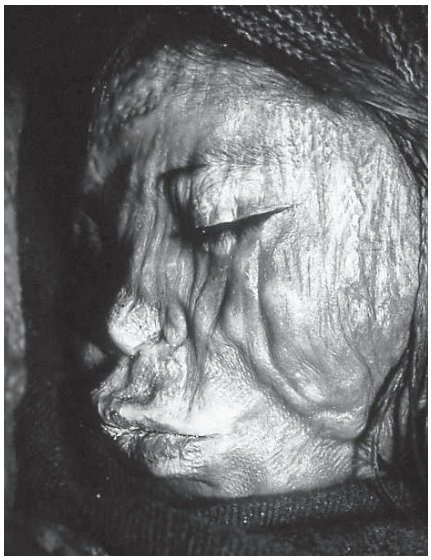

Fig. 1 - Infrared photograph of the Prince of El Plomo. Due to light exposure the facial paintings have almost disappeared.

Chile. The body and accompanying grave goods were acquired by the National Museum of Natural History, Santiago, and preserved in a glass-fronted freezer until today. Examination of the body at the time revealed the presence of *Trichuris* ova (Pizzi and Schenone, 1954), ectoparasite eggs – *Pediculus humanis capitis* –, and numerous skin lesions (Prunes, 1957). New studies in 1982 using radiography, computed tomography and electron microscopy ascertained the precise nature of the lesions and described the presence of *Papilloma* virus in two verrucae on one of the child's hand (Horne & Quevedo, 1984). In this paper we present the results of recent radiological (computerized imaging), molecular and chemical investigations.

Recent el plomo mummy studies

Paleoradiology

Ever since the mummified body was acquired by the Museum in 1954 the main curatorial objective has been to preserve the integrity of the corpse and radiological studies have been the method of choice because of their non-destructive approach. The first evaluation with conventional radiography was performed at the Calvo Mackenna Children's Hospital the same year the mummy was discovered. No pathological findings were reported (Merello, 1957). In 1982, investigations with computed tomography did not reveal any new clinical findings except corroborate the excellent state of preservation of the body (These studies were never published).

A new study was carried out at the Department of Radiology of the Clinical Hospital of the University of Chile in 2003. The purpose of this evaluation was to search for evidence of disease as well as check the preservation status of the body. A single volumetric acquisition of the whole body was performed with a multislice CT scan (Siemens Somatom Emotion Duo) followed by conventional and MIP (Major Intensity Projection) multiplanar reconstructions as well as three dimensional (3D) reconstructions: SSD (Shadow Surface Display) and VRT (Volume Rendering Technique).

Exhaustive analysis of internal organs revealed that most of them are distinguishible but with different degrees of shrinkage and volume loss. The best preserved organ is the central nervous system (Fig. 2) whilst the oropharinx, esophagus and stomach are partially filled with contents. There are also contents in the rectum and intergluteal region (Fig. 3). This suggests the possibility of vomiting and soiling at the time of death.

The musculoskeletal system is also well preserved (Fig. 4). The subcutaneous fat layer thickness together with bone mineralization and development suggest a normal

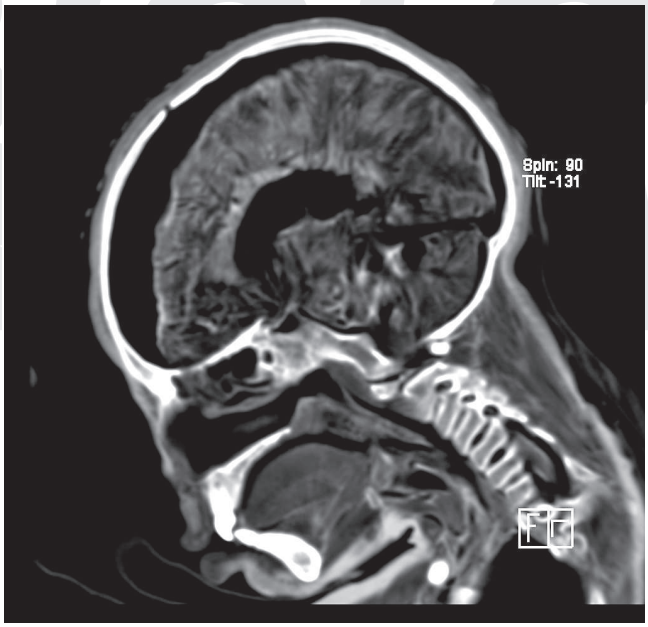

Fig. 2 - Mid-sagittal reconstruction of the skull. Anatomical structures show excellent state of preservation.

Fig. 3 - Mid-sagittal reconstruction of the whole body. Although viscera are diminished in volume they maintain their anatomical position.

nutritional status. There is no evidence of traumatic injuries related to death. Skeletal development and dental calcification patterns confirm an age of 8 years old.

Molecular studies

During the 2003 radiologic examination, small samples of muscle tissue were removed from the gluteal region for histological and molecular analyses. Histological studies corroborated the magnificent preservation of the tissues but did not reveal any pathological condition.
Molecular analyses included determination of Amerindian mitichondrial DNA (mtDNA) haplotype and molecular

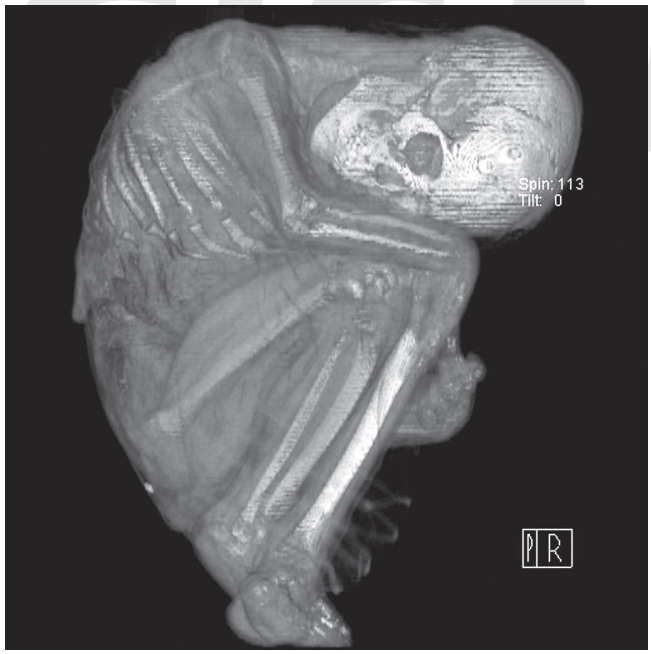

Fig. 4 - 3D reconstruction of the body describing the musculoskeletal system.

ABO blood group. Preparation of samples and mtDNA amplification were done acoording to standard methods at the Department of Human Genetics of the School of Medicine of the University of Chile (Höss & Pääbo, 1993; Olsson & Chester, 1996).
Haplotype characterization revealed that the mummy had haplotype C. It is noteworthy that this haplogroup has a low frequency among the living quechua and aymara populations (Merriwether et al., 1995).
Molecular ABO blood group determination indicated a blood type O. This finding corroborates the original blood group determination of 1954 (Mostny 1957) but contradicts the 1982 analyses which suggested that the child had blood type A (Horne and Quevedo, 1984; Horne 1996). Likewise, it is consistent with the fact that all Ameridindian groups are blood type O. In addition, the molecular genotype of the mummy for the ABO blood group system was determined to be $O^{I}O^{IV}$, that is heterozygote for the O^{I} and O^{IV} alleles.

Chemical Studies

Concentrations of cocaine and the major metabolites were measured quantitatively in hair samples using a highly sensible method based on gas chromatography/ mass spectrometry – ion trap (GC/MS-IT) at the Antidoping Laboratory of the Faculty of Chemical and Pharmacological Sciences of the University of Chile. Presence of cocaine was confirmed therefore indicating that the boy was probably chewing coca-leaves. Moreover, among the grave goods there was a purse covered with red and white feathers which contained numerous coca leaves.
Since the boy was most probably from the altiplano (i.e. northern Chile or southern Bolivia), he must have walked over 2.000 kms to reach Cerro El Plomo. During this long

and strenous walk he probably chewed coca on a daily basis.

Conclusions

Recent studies of the Prince of El Plomo have produced important new information which either corroborate or dismiss the results of previous investigations. As technology advances and new methodologies are developed, new insights into the the body of this Inca noble will provide more data regarding the biology of ancestral populations. Consequently, proper preservation of this mummy as well as other bodies found in the Andean region are extremely important for future biomedical research.

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