

“Lo Quarter”: the Alghero Plague Cemetery (1582- 1583 AD)

R. Bianucci^{1,2}, V. Giuffra¹, E. Ferroglia³, M. Milanese⁴, G. Fornaciari¹

¹ Divisione di Paleopatologia, Storia della Medicina e Bioetica, Dipartimento di Oncologia, dei Trapianti e delle Nuove Tecnologie in Medicina, Università di Pisa, Italia

² Laboratorio di Scienze Criminalistiche, Dipartimento di Anatomia, Farmacologia e Medicina Legale, Università di Torino, Italia. E-mail: raffaella.bianucci@unito.it

³ Laboratorio di Parassitologia e Malattie Parassitarie, Dipartimento di Produzioni Animali, Epidemiologia e Ecologia, Università di Torino, Italia

⁴ Dipartimento di Storia, Università di Sassari, Italia

KEY WORDS: *Yersinia pestis*, RDT for plague, 16th century Sardinia, funerary practices.

Introduction

In 1582- 1583 a plague outbreak devastated the seaport of Alghero (Sassari, Sardinia).

A sailor who had disembarked from a ship coming from Marseilles around mid- November 1582 was thought to have been the initial harbinger of the infection (Manconi, 1994).

The first new casualty was registered on November 19th 1582. The epidemic lasted eight months and ended in June. After June 14th 1583, no new cases of contagion were recorded. The outbreak caused the death of it caused the death of around 60% of Alghero's population and implied the digging of mass graves.

During a rescue excavation carried out in 2008 in the courtyard of the former Jesuits' College in San Michele-Lo Quarter neighbourhood, the skeletal remains of 202 putative plague victims dating to the 1582- 1583 outbreak were unearthed.

Sixteen trenches and ten rectangular multiple graves were identified. Each trench measured 5- 6 meters in length and 0,90 m in depth and contained the remains of 10 to 15 individuals. The highest number of victims was recovered in trench n. 10, which contained up to 30 individuals (Fig. 1). These individuals had died simultaneously or in a short lapse of time. The rectangular multiple burials, which belongs to the same funerary phase, contained an average number of six individuals (Milanese, 2010).

Materials and Methods

To detect *Yersinia pestis* we resorted to the Rapid Diagnostic Test for plague (RDT), an immunochromatographic assay, which detects the specific F1 envelope glycoprotein. The RDT has been already extensively used in plague retrospective diagnosis in several putative mass burials throughout Europe (Bianucci et al., 2007, 2008, 2009; Haensch et al., 2010; Kacki et al. 2011). Since proteins are



Fig. 1. “Lo Quarter” putative plague cemetery: trench n. 10 contains the highest number of victims (30 individuals). The side- to- side deposition can be pointed out.

more stable than ancient DNA over long time period and in different environments, the dipstick assay appears to be more sensitive than PCR in plague retrospective diagnosis (Haensch et al., 2010; Kacki et al., 2011).

We used spongy bone as a source of *Y. pestis* F1 antigen. Principle of the dipstick assay, protocol and methods for semi- quantitation of the AgF1 concentrations in ancient specimens have been described elsewhere (Bianucci et al., 2008).

Preliminary investigations were carried out on ten individuals. Four victims unearthed from trenches n. 3, 7, 10 and 13 and 6 individuals from multiple burial T128 were used in the tests (Tab.1). Anthropological analysis attributed the human remains to 8 adults (3 males and 5 females) and 2 subadults (Buikstra and Ubelaker, 1994).

Additionally, RDT was applied on ten 14th- 15th century individuals exhumed from the “Eglise des Cordeliers” graveyard in Briançon (Hautes- Alpes, France), a site to be known to be free from plague at the end of the Middle

Ages- beginning of the Modern Age. Soil samples from the Alghero trenches and from multiple burial T128 were also tested in order to exclude cross- reaction with soil bacteria.

The AgF1 concentrations in the above samples ranged from 2.5 ng/ml to 0.5 ng/ml. Our results provide strong evidence for the presence of

Sample code number	Sex	Age (yrs)	Bone	RDT results	[AgF1] bone concentrations (ng/ml)
US 2002 Trench 3	M	25- 30	thoracic vertebra	positive	2.5-1.25 ng/ml
US 2285 Trench 7	F	25-30	thoracic vertebra	positive	1.25 ng/ml
US 2523 Trench 10	F	25-30	lumbar vertebra	positive	0.625 ng/ml
US 5123 Trench 13	F	20-22	thoracic and lumbar vertebrae	positive	0.625 ng/ml
US 2451 T128	M	19- 20	right calcaneum	negative	absent
US 2452 T128	M	12-14	lumbar vertebrae	negative	absent
US 2456 T128	F	4- 5	lumbar vertebrae	positive	0.5 ng/ml
US 2457 T128	ND	1.5-2	thoracic and lumbar vertebrae	positive	0.5 ng/ml
US 2465 T128	F	14- 15	left talus	negative	absent
US 2466 T128	M	23- 25	thoracic vertebrae	negative	absent

Table 1. Code numbers of the samples, their sex, age, the results of the RDT applied to spongy bone and the AgF1 concentrations.

Results

Y. pestis F1 antigen was identified in 100% of the tested specimens from trenches n. 3, 7, 10, 13 (Fig. 2) and in two of the six individuals (33.3%) from multiple burial T128.

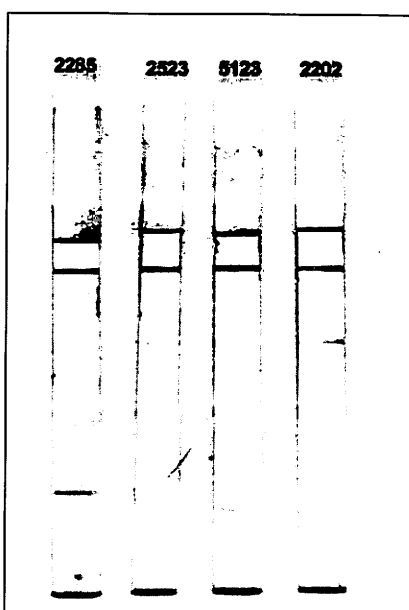


Fig. 2. Rapid diagnostic test for *Yersinia pestis* F1 antigen. From left to right, the positive results of the samples US 2285, US 2523, US 5123 and US 2202.

Y. pestis in the human remains we analyzed. All control samples as well as soil samples (100%) confirmed their negativity to *Y. pestis* infection. Cross- reaction with soil bacteria was therefore excluded.

Discussion

We provide biological evidence for the presence of *Y. pestis* in the putative plague victims we analyzed and, therefore, we confirm the archaeological data following which "Lo Quarter" cemetery served as a plague burial site during the 1582- 1583 outbreak (Milanese, 2010).

Local documentary sources imply that during the epidemic, many efforts were made by the city government and by the *Protomedicus* Quinto Tiberio Angelerio who had been entrusted with the task of containing the epidemic (Scanu, 1584; Angelerii, 1588; Fara, 1835; Manconi, 1994). A triple sanitary cordon was established and triple barriers were built around Alghero's boundaries. Horse guards checked the city walls.

Angelerio's health policy emphasized disease prevention through the isolation of suspected or infected patients. The plague hospitals were kept closed by establishing strict guards thus avoiding the risk of plague patients mingling with the rest of the population. Patients were provided

with all supplies and medicine they needed. with supplies and medicine they needed. Two secluded infirmaries where to isolate plague patients ("lazzaretto") and suspected cases ("tancat"), respectively, were chosen.

Gravediggers were selected among those who had already contracted the plague during a previous outbreak occurred in another town and had survived. Gravediggers had to live separately from the rest of the community and far from the hospital.

It was mandatory to bury plague victims within 6 hours from their deaths. The corpses had to be buried in secluded cemeteries. Long and deep trenches had to be excavated and the corpses had to be covered with lime thus avoiding the air corruption and mephitic vapours (Angelierii, 1588). The archaeological excavation brought to light some of the long and deep trenches that had been excavated during fall- winter 1582 and spring 1583. The taphonomic analysis of the 16 trenches and 10 multiple burials showed that the inhumations had occurred simultaneously or, at least, in a very short lapse of time (Milanese, 2010).

Inside each trench, the victims had been deposited with extreme care, in dorsal decubitus and following a side- to-side deposition. The head of each deceased was laid on the pelvis of the corpse that had been previously deposited and so on. No evidence for violence was found in the exhumed skeletons.

In most cases neither personal belongings, nor traces of clothing, were found in contact with the skeletons. The taphonomic analysis plus the evidence of bronze pins suggests that these victims had been undressed and wrapped in shrouds as demanded by the sanitary restrictions.

In a small number of cases, instead, personal belongings were found in contact with some individuals i.e. a necklace made out of coral and bone beads, a jasper pendant and a jet pendant, several jet buttons and a bag containing bronze

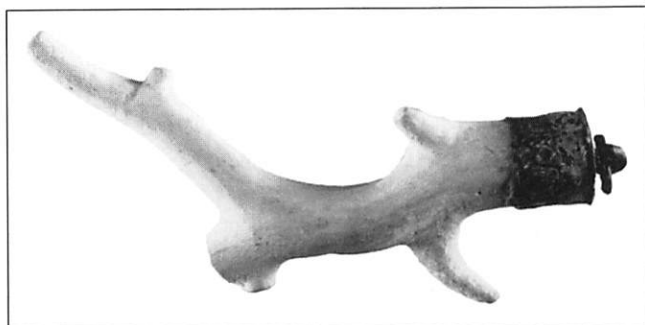


Fig. 3. Coral amulet with silver cap; this pendant was found associated to the skeletal remains of a woman unearthed from trench n. 10.

coins dating to 1492 AD (Milanese, 2010) (Fig. 3). These victims might well correspond to the plague victims who died before being admitted to the infirmaries and that had been buried several hours or even days after their deaths. These plague victims were buried dressed along with their belongings because gravediggers wanted to minimize their contact with the infected bodies.

Conclusions

The immunological investigation fully corroborates the archaeological data following which the "Lo Quarter" cemetery corresponds to one of the secluded areas in which the long and deep trenches were excavated during the epidemic.

Due to its size and peculiarities, the Alghero plague cemetery represents an *unicum* in Italy and can be compared only to the Martigues plague cemetery (France) which, however, dates to a later period (1720- 1721 AD) (Tzortzis and Signoli, 2009; Bianucci *et al.*, 2010).

Acknowledgments

The Alghero Plague Project is funded by Fondazione Banco di Sardegna. Dr Minoarisoa Rajerison is highly acknowledged for having provided the RDT for this study.

References

- Angelierii Quinti Tyberii, 1588. *Ectypa pestilentis status Algeriae Sardiniae. Ad Ill. D.D. Michaellem A. Moncada Regni Proregem etc.* Calari: 110.
- Bianucci R., Rahalison L., Ferroglio E., Rabino Massa E., Signoli M., 2007. Détection de l'antigène F1 de la peste à l'aide d'un Test de Diagnostic Rapide. *C.R. Biologies*, Vol. 330, Issue 10: 747- 754.
- Bianucci R., Rahalison L., Rabino Massa E., Peluso A., Ferroglio E., Signoli M. 2008. Plague Detection in Ancient Human Remains: An Example of Interaction between Archaeological and Biological Approaches (south-eastern France, 16th, 17th and 18th centuries). *Am. J. Phys. Anthropol.*, 136(3): 361- 367.
- Bianucci R., Rahalison L., Peluso A., Rabino Massa E., Ferroglio E., Signoli M., Langlois J.V., Gallien V. 2009. Plague immunodetection in remains of religious exhumed from burial sites in central France. *J. Archeol. Sci.*, 36: 616- 621.
- Bianucci R., Tzortzis S., Fornaciari G., Signoli M. 2010. Historical and Biological Approaches to the Study of Modern Age French Mass Burials. *Medicina nei Secoli*, 22(1- 3): 273- 296.
- Buikstra, J.E., Ubelaker D.H. (eds) 1994. *Standards for Data Collection From Human Skeletal Remains*, Fayetteville, Arkansas, Arkansas Archeological Survey Research Series No. 44.
- Fara G.F. 1835. *De rebus sardois*, Torino: 286.
- Hänsch S., Bianucci R., Signoli M., Rajerison M., Schultz M., Kacki S., Vermunt M., Weston D.A., Hurst D., Achtman M., Carniel E., Bramanti B. 2010. Distinct clones of *Yersinia pestis* caused the Black Death. *PLoS Pathogens*, 6(10): e 1001134. doi:10.1371/journal.ppat.101134.
- Kacki S., Rahalison L., Rajerison M., Ferroglio E., Bianucci R. 2011. Black Death in the rural cemetery of Saint-Laurent-de-la-Cabrerisse (Aude-Languedoc, southern- France, 14th century): immunological evidence. *J. Archaeol. Sci.*, 38: 581- 587.
- Manconi F. 1994. *Castigo de Dios, La grande peste barocca nella Sardegna di Filippo IV*, Donzelli Editore, Roma: 17- 25.
- Milanese M. (a cura di) 2010. *Lo scavo del cimitero di San Michele ad Alghero (fine XIII – inizi XVII secolo)*, Felici Editore, Pisa.
- Scanu P. 1584. La Pesta de 1582- 1583 a l'Alguer. L'obra de Quinto Tiberio Angelerio. Discorso tenutosi presso l'Academia de Ciències Mèdiques de Catalunya i de Balears in data 3-XI-1584.
- Tzortzis S., Signoli M. 2009. Les tranchées des Capucins de Ferrières (Martigues, Bouches-du-Rhône, France, Un charnier de l'épidémie de peste de 1720 à 1722 en Provence. *C.R. Paleovol.*, 8: 749- 760.