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Disease not genetic but infectious: multiple tuberculomas and fibrinous pericarditis as symptoms pathognomonic for tuberculosis of Frederic Chopin

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Abstract
Chopin's heart, generally enlarged, presented morphologic features pathognomonic for fibrinous pericarditis presumably of tubercular origin: multiple nodular hyalinization foci—tuberculomas and fibrillary coating covering the whole surface of pericardium ("frosted heart"). We show that these features differ significantly from post mortem-formed inorganic crystalline deposits, mold colonies, or fat deposits known from various preserved anatomical objects stored for a long period of time. In our opinion, these pathologies fully justify the claim that chronic cavernous pulmonary, laryngeal, and intestinal tuberculosis presents itself as the most plausible diagnosis of Frederic Chopin and that rapidly progressing tubercular pericarditis became the immediate cause of his death.

Keywords Frosted heart · Tuberculosis · Crypt

Introduction

The great Polish composer and pianist Frederic Chopin died in Paris in 1849 in the presence of his sister Ludwika Jędrzejewicz. The post-mortem examination was performed by a famous French anatomist and physician, Jean Cruveilhier. Unfortunately, the autopsy record was lost in a fire of police archives in Paris in 1871 and only an oral communication of Cruveilhier to Jane Stirling, Chopin's former student and friend, remains an exclusive, although anecdotal, source of medical information till today (Neumayr 1997). According to Chopin's will, his heart was removed during the autopsy and his body was buried in the Pere Lachaise cemetery in Paris. The next year, Ludwika Jędrzejewicz transported the preserved heart of her brother in a glass jar to her household in Warsaw. After some years, the jar was transferred into the Holly Cross Church and stored there in the crypt in a church's pillar since then.

Based on a visual, noninvasive analysis of Chopin's preserved heart, we communicated previously (Witt et al. 2018; Editorial 2017) that most likely a tuberculous pericarditis, rapidly progressing within a rather short period of time, might have been an immediate cause of his death. In light of this, the diagnosis of the underlying disease of the composer as tuberculosis can be claimed with considerable certainty.

Here, we show that pathologic lesions identified in Chopin's heart are not post-mortem phenomena but are pathognomonic for tuberculosis, confirming the most likely diagnosis made for the composer.

Materials and methods

On April 2014, an inspection of the crypt with Chopin's heart in the St. Cross Church in Warsaw, Poland, was performed in order to evaluate the preservation status and, if necessary, to undertake a rescue action of the specimen. Prior to the inspection, it was decided that only a nondestructive approach

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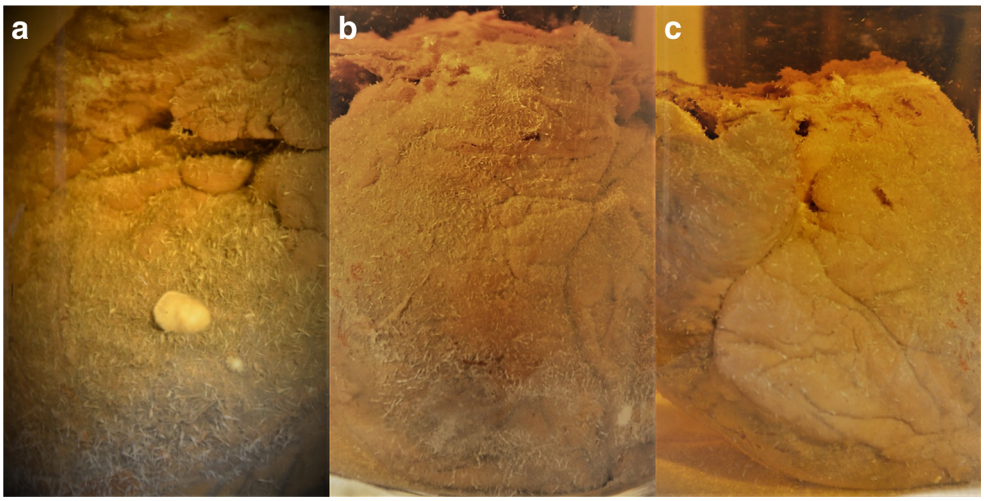

Fig. 1 Details of the Chopin's heart pericardium from various sides: **a** tuberculomas; **b** "bread and butter" appearance; **c** "frosted heart" appearance

exclusively based on a genetic testing of DNA from preservation fluid, not the heart per se, for exploration of the composer's malady, might be considered. Any invasive procedure on the specimen itself was a priori ruled out. An access to the specimen was limited to only 4 hours; any analysis requiring outside apparatus like computer tomography was not approved.

After the opening of the crypt, the glass jar was removed from a double wooden box: the outer box most likely made of oak wood, the inner box giving an impression of ebony, with lead screens inside of the outer box and a silver plaque on the lid of the inner box, engraved with inscriptions in a Polish language stating the dates of birth and death of Frederic Chopin as March 1, 1810, and October 17, 1849, respectively. The crystal glass jar was tightly closed with a ground glass plug (Witt et al. 2018). The specimen inside was submerged in an amber-brown liquid: it is known from historic sources that it could have been brandy, in those days the only available alcohol solution of a concentration high enough (approximately 60%) optimal for proper tissue preservation. Such applications of brandy date back at least to the time of the French Revolution. The level of the liquid in the jar fell only by 0.5 cm, without exposing the specimen itself.

Since the specimen was evidently in an excellent condition, it was decided not to open the jar, to avoid any risk of an adverse effect leading to a possible decay. Thus, any chemical, genetic, or microscopic analysis of the conservation fluid was given up. There have been only a thorough photographic documentation made, which was then subjected to a careful analysis (Witt et al. 2018).

After an inspection and supplementing the hot wax to the jar's seal to prevent future evaporation, the specimen was returned to the crypt; the next inspection was scheduled after a routine period of approx. 50 years.

Results and discussion

We found it highly convincing that the generally enlarged heart displayed features pathognomonic for tuberculosis infection and noticeable morphologic features which were not the result of post-mortem processes, like blood precipitates (brownish "tears") visible mostly along a ventricular autopsy incision (Witt et al. 2018).

Several glossy, whitish-pearl nodules, slightly protruding from the surface of the myocardium (Fig. 1a), strikingly resemble myocardial tuberculomas as published previously (Rosenbaum and Linn 1948). Nodular hyalinization foci resulting from organization of serosanguineous effusions by granulomatous caseation, caused by tuberculous spread within the myocardium, affected preferentially the right heart

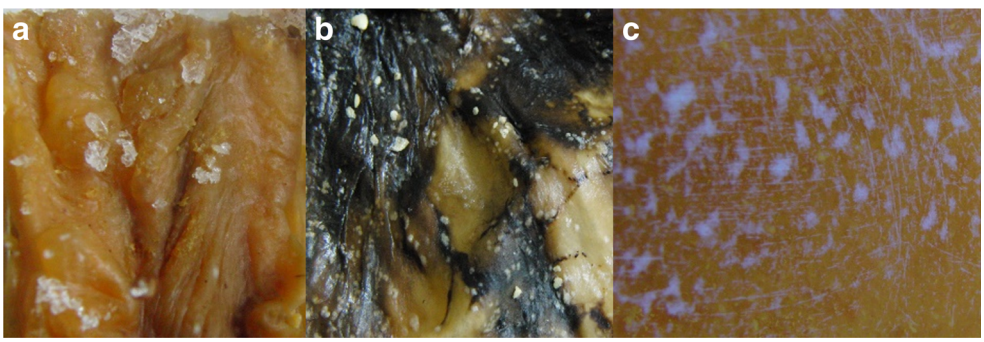

Fig. 2 Effects of post-mortem phenomena on various preserved anatomical object: **a** crystalline deposits of preservation fluid components; **b** mold colonies; **c** fat deposits on the glass surface

(Mayosi et al. 2005). A sarcoidal origin of such lesions does not have justification from Chopin's medical history. The nodules were significantly different from inorganic crystalline deposits or sharp-shaped white mold colonies known to be formed post-mortem (Fig. 2a, b, respectively). We have identified such artifactual phenomena in several cases in our collection of ~2000 tissue samples. Such deposits occur mainly in old objects with significantly decreased levels of conservation fluid which was not the case for Chopin's heart.

These presumably tuberculous nodules were accompanied by a firm covering of the whole pericardium with a white tapestry-like coating, which was widespread fairly evenly over the surface and which was clearly visible regardless of the angle of observation, being a proof of an inflammatory process affecting the entire organ (Fig. 1a–c). This morphology can be considered a pathological picture of fibrinous pericarditis with "frosted heart" (Fig. 1a, c) or "bread and butter" (Fig. 1b) appearance, which was not caused by the accumulation of post-mortem ionic precipitates that would occur locally in separate foci. Definitely, this was the reason for Dr. Cruveilhier to declare surprisingly that "the lungs were less affected than the heart" (Neumayr 1997). In our collection, we have found downy spots, which were likely fat deposits, resembling these present on Chopin's heart, in a container with a high level of conservation fluid which had been stored for about a century. However, they were not present on the object itself but exclusively on the inner glass surface of the container (Fig. 2c).

Tuberculous pericarditis, a rare complication of tuberculosis, currently accounts for 1–4% of pulmonary tuberculosis and remains the leading cause of pericarditis worldwide. In Chopin's time, tuberculosis, with a mortality reaching 25–30% and with 90% of children/adolescent population infected, was romantically idealized as an elusive inspiration of artists under the Greek name of *spes phthisica*, a special euphoric creative energy attributed to consumptives, a primary example of the widely discussed relationship between ill health and artistic creativity (Abbott 1982). The death of Chopin's younger sister, Emilia, with a similar clinical picture shows the contingency of household spread of the disease rather than being a proof of the familial occurrence of a genetic disorder like cystic fibrosis (Majka et al. 2003).

Conclusions

The myocardial lesions found on a Chopin's heart, i.e., tuberculomas and fibrinous pericarditis, cannot be attributed to post-mortem processes but most likely result from mycobacterial infection of the whole heart. Although chronic cavernous pulmonary, laryngeal, and intestinal tuberculosis presents itself as the most plausible diagnosis of Frederic Chopin, only an analysis of the remains of the members of the Chopin family, potentially available for an analysis in the Powązki cemetery in Warsaw, might shed light on infectious and/or genetic factors present in Chopin's family.

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Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

Ethical approval Non applicable.

Informed consent Non applicable.

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