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The Plague of Thebes, a Historical Epidemic in Sophocles’ Oedipus Rex

Technical Appendix

Table. Characteristics of pathogens possibly responsible for the plague of Thebes described by Sophocles in Oedipus Rex*

<table>
<thead>
<tr>
<th>Pathogen</th>
<th>Disease</th>
<th>Zoonosis in cattle</th>
<th>Stillbirth/ miscarriage</th>
<th>Infertility</th>
<th>Highest reported acute mortality rate</th>
<th>Highly contagious (droplets/aerosol transmission)</th>
<th>Epidemics have been described</th>
<th>Described as early as 5th century BC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yersinia pestis</td>
<td>Plague</td>
<td>No (reported mainly in rodents, cats, camels) (1,2)</td>
<td>NA</td>
<td>NA</td>
<td>100% (1,2)</td>
<td>Yes (2)</td>
<td>Yes (1,2)</td>
<td>Probably yes (1350 BC) (3)</td>
</tr>
<tr>
<td>Leishmania spp.</td>
<td>Leishmaniasis</td>
<td>Yes (4)</td>
<td>Yes (≤ 10.5% for cutaneous and visceral) (5)</td>
<td>NA</td>
<td>70% (6)</td>
<td>No (sandfly bite) (7)</td>
<td>Yes (7)</td>
<td>Probably yes (7th century or possibly as easily as 2500 to 1500 BC) (8)</td>
</tr>
<tr>
<td>Leptospira spp.</td>
<td>Leptospirosis</td>
<td>Yes (9)</td>
<td>Yes (in acute infection) (9)</td>
<td>NA</td>
<td>50–70% (10)</td>
<td>No (rarely reported direct transmission between humans) (9)</td>
<td>Yes, usually in association with rainfalls, flooding and rodent infestation (9)</td>
<td>Probably yes (recognized as an occupational hazard of rice harvesting in ancient China) (9)</td>
</tr>
<tr>
<td>Hepatitis E Virus</td>
<td>Hepatitis E (13)</td>
<td>Yes (13)</td>
<td>Yes (13)</td>
<td>NA</td>
<td>4% (13) (73% in pregnancy) (14)</td>
<td>No (13,14)</td>
<td>Yes (13,14)</td>
<td>No (earliest outbreak attributed to HEV was in Delhi, 1955) (13,15)</td>
</tr>
<tr>
<td>Coronaviridae</td>
<td>Common cold, SARS</td>
<td>Yes (16)</td>
<td>NA</td>
<td>NA</td>
<td>15% (55% in persons &gt;60 years of age) (17)</td>
<td>Yes (17)</td>
<td>Yes (16,17)</td>
<td>No (first characterized in the 1960s) (18)</td>
</tr>
<tr>
<td>Influenzavirus A</td>
<td>Influenza</td>
<td>Yes (19)</td>
<td>Yes (20)</td>
<td>No (21)</td>
<td>5–10% (22) (may be higher) (23)</td>
<td>Yes (24)</td>
<td>Yes (22,23)</td>
<td>Yes (25)</td>
</tr>
<tr>
<td>West Nile virus</td>
<td>West Nile virus infection</td>
<td>No (26,27)</td>
<td>No (26,27)</td>
<td>NA</td>
<td>10% (26)</td>
<td>No (26–28)</td>
<td>Yes (26,27)</td>
<td>Probably not (molecular dating shows low possibility of human infection before 1000 years ago) (29)</td>
</tr>
<tr>
<td>DEN 1-4 Flaviviruses</td>
<td>Dengue and dengue hemorrhagic fever</td>
<td>Not the same virus in humans and cattle (30,31)</td>
<td>Not in a high rate (32)</td>
<td>NA</td>
<td>47% (33)</td>
<td>No (30)</td>
<td>Yes (30)</td>
<td>No (earliest record of Dengue symptoms found in China, during Chin dynasty, 265-420 A.D.) (30)</td>
</tr>
</tbody>
</table>

*Reported mainly in rodents, cats, camels (1,2)
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<tr>
<td><em>Brucella abortus</em></td>
<td>Brucellosis</td>
<td>Yes (34)</td>
<td>Yes (35)</td>
<td>No (34)</td>
<td>80% in cases in which endocarditis was concurrently present (37)</td>
<td>Yes (38)</td>
<td>Yes (39)</td>
<td>Probably yes (known since the time of Hippocrates) (40)</td>
</tr>
<tr>
<td><em>Listeria monocytogenes</em></td>
<td>Listeriosis</td>
<td>Yes (41)</td>
<td>Yes (42)</td>
<td>No (43)</td>
<td>63% (42)</td>
<td>No (42)</td>
<td>Yes (42)</td>
<td>No (early 20th century) (44)</td>
</tr>
<tr>
<td>Orthopoxviridae</td>
<td>Smallpox</td>
<td>No (45)</td>
<td>Yes (46)</td>
<td>Yes (47)</td>
<td>30% (48)</td>
<td>Yes (48)</td>
<td>Yes (48)</td>
<td>Yes (observations from 1100-1580 BC, even earlier phylogenic origin) (49)</td>
</tr>
<tr>
<td><em>Measles virus</em></td>
<td>Measles</td>
<td>Yes (not reported in cows) (50)</td>
<td>Yes (51)</td>
<td>No (52)</td>
<td>15% (after encephalitis) (52)</td>
<td>Yes (52)</td>
<td>Yes (53)</td>
<td>No (not described BC, and recent phylogenic analysis showed its origin in 11th–12th century AD) (54)</td>
</tr>
<tr>
<td><em>Salmonella typhi</em></td>
<td>Typhoid fever</td>
<td>No (55)</td>
<td>Yes (56)</td>
<td>NA</td>
<td>30% (when left untreated) (57)</td>
<td>No (58)</td>
<td>Yes (59)</td>
<td>Yes (60)</td>
</tr>
<tr>
<td><em>Francisella tularensis</em></td>
<td>Tularemia</td>
<td>Yes (mainly on rabbits, ticks, deerflies, squirrels) (61)</td>
<td>No (reported in sheep) (62)</td>
<td>NA</td>
<td>60% (63)</td>
<td>Yes (63)</td>
<td>Yes (63)</td>
<td>Probably yes (earliest outbreak credited, in 1715 BC Canaan) (64)</td>
</tr>
<tr>
<td><em>Yersinia enterocolitica</em></td>
<td>Gastroenteritis</td>
<td>No (mainly in pigs, dogs, cats, sheep and wild rodent strains) (65)</td>
<td>No (reported in sows, cattle) (66)</td>
<td>NA</td>
<td>50% (after septicemia) (67)</td>
<td>No (65)</td>
<td>Yes (68)</td>
<td>Probably not (Yersinia spp. is an ancient pathogen (3), first recognized reference to Y. enterocolitica in the USA in 1934 (69))</td>
</tr>
<tr>
<td><em>Rickettsia prowazekii</em></td>
<td>Epidemic typhus</td>
<td>No (mainly in flying squirrels) (70)</td>
<td>NA</td>
<td>NA</td>
<td>60% (70)</td>
<td>Yes (70)</td>
<td>Yes (71)</td>
<td>Yes (may have originated millions of years ago) (72)</td>
</tr>
<tr>
<td><em>Lymphocytic Choriomeningitis Virus</em></td>
<td>Choriomeningitis</td>
<td>No (mainly in rodents, house mice, pet hamsters) (73)</td>
<td>Yes (74)</td>
<td>NA</td>
<td>30% (among infants diagnosed with congenital infection) (74)</td>
<td>Yes (73)</td>
<td>Yes (75)</td>
<td>Probably yes (LCMV is quite ancient and the extensive diversity of the virus has accumulated over the past 1,000–5,000 years) (76)</td>
</tr>
<tr>
<td><em>Aspergillus spp.</em></td>
<td>Aspergillosis</td>
<td>Yes (77)</td>
<td>No (most frequent cause of abortions in cattle) (77,79)</td>
<td>NA</td>
<td>86% (treated immunocompromised patients) (77)</td>
<td>Yes (77)</td>
<td>Yes (79)</td>
<td>No (first introduced in 1729) (80)</td>
</tr>
</tbody>
</table>

*NA, not available; SARS, severe acute respiratory syndrome; LCMV, lymphocytic choriomeningitis virus; HEV, hepatitis E virus; BC, before Christ.*
References


