MALARIA IN GRAECO-ROMAN TIMES
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ABSTRACT

Malaria is an ancient disease caused by the Plasmodium organism. Evidence shows that P. falciparum causing malignant tertian malaria originated in Central Africa 165 million years ago and migrated towards the Mediterranean at the end of the last Ice Age. P. vivax and P. malariae causing more benign malaria probably originated in South-East Asia. In this study the occurrence of malaria in the Mediterranean region in Classical times is studied. Although no evidence of the typical malarial fever patterns can be found in the medical papyri of Ancient Egypt, modern DNA technology shows evidence of malarial infection in mummies of the third millennium BC. The writings of Hippocrates, Celsus and Galen in particular record descriptions of periodic fevers which correspond closely to the known varieties of malaria during Graeco-Roman times. Further evidence of malarial fevers in the literature of the period is reviewed and it is concluded that malaria was well established as a serious disease in the Eastern Mediterranean of the 5th century BC.

Although malaria is today still an international scourge affecting 300-500 million people in mostly tropical and subtropical regions and causing 1.5-2.7 million deaths per annum (Goldsmith 1999:1373-75), evidence shows it to be an ancient disease (Sallares 2002:25-31). In this study its occurrence in Mediterranean areas during Classical times is reviewed.

Modern concepts

The name malaria, derived from ‘mala’ria’ (bad air) in Italian was probably first used by Cornaro in a publication of 1440. The concept became known in the English world through a contribution by Walpole in 1740, and theories regarding malaria’s miasmatic origins were only dispelled in the late 19th century when Manson (1877) described the malarial cycle with the mosquito as vector, and Laveran (1880) discovered the causative parasite in human blood (Sallares 2002:7-8; Jones 1975:472).
Causation

Of the four species of the malarial parasite Plasmodium capable of causing human malaria, P. ovale occurs only in West Africa, while P. falciparum, P. vivax and P. malariae are found in the Mediterranean basin. DNA-sequencing studies show that P. falciparum originated in Central Africa 165 million years ago, and because of its intolerance of temperatures below 20°C migrated out of Africa only after the termination of the last Ice Age. P. vivax and P. malariae, tolerant of colder temperatures, probably originated in South-East Asia (Sallares 2002:25-28).

The parasite develops inside the Anopheles mosquito and humans are only infected through the bite of a female of the species. The mosquito breeds in well-aerated standing water, can only fly a few kilometres in non-windy conditions, and characteristically enters dwellings to bite after dark. The Anopheles mosquito is found in fossils at least 26-38 million years old, and species like A. sacharowi and A. labranchiae, which cause Mediterranean malaria in modern times, probably existed there in Classical times and earlier (Goldsmith 1999:1373-80; Sallares 2002:26-35, 44).

Clinical picture

Because of the mosquito’s breeding requirements, malaria shows a typical seasonal incidence, highest in the warm and wet season. After entering the body, the parasite replicates in the liver for up to two weeks (the asymptomatic incubation period) and then moves into the blood stream to infect the red blood cells. Fever lasting up to a day results when infected red cells disintegrate. It is associated with rigors, alternating sensations of heat and cold, and profuse perspiration. The liberated parasites immediately reenter other red blood cells to initiate a cycle which may last for as long as a year or more, depending on the parasite.

With P. falciparum, fever characteristically recurs every 48 hours (tertian fever) and untreated may continue for months, often with serious complications, such as cerebral malaria, renal failure (black water fever) and death. Because of the grave prognosis and the observation that days between peaks often show a low grade fever, the condition became known as ‘malignant’ or ‘sub-tertian’ fever. (The origin and precise evaluation of the terms ‘semi-tertian’ or ‘sub-tertian’ are unclear; cf. Burke 1993:2258; Sallares 2002:18.) With multiple infections by different subspecies of P. falciparum, fever peaks may even occur daily (‘quotidian fever’), resembling many other infectious diseases (Goldsmith 1999:1375-89; Jones 1975:475-82).
P. vivax also produces fever peaks every 48 hours, may continue for months, and often relapses after apparent cure. Because it rarely causes death, it is known as 'benign tertian fever'.

P. malariae, the most benign parasite, causes fever peaks every 72 hours, known as 'quartan fever'. It is the most chronic of the three malarial diseases. Death is uncommon, but it may cause a fatal renal complication, nephrotic syndrome, characterised by gross oedema (swelling).

Chronic malaria, of whichever cause, is characterised by enlargement of the spleen and degrees of malnutrition and weight loss, anaemia and hence secondary infections. In endemic areas acute malaria is commonest among children, and pregnant women are prone to abortion. Older people develop relative immunity to the disease, an immunity which persists through repeated reinfection with low-grade malaria.

Evidence is that the above clinical picture has changed little from that in Classical times (Sallares 2002:23-42).

**Historical malaria**

Evidence of malaria in a specific community may be obtained from contemporary written records, or through the detection of physical evidence of disease in human remains. Malaria leaves virtually no recognisable pathognomonic lesions in the bodies of deceased victims (Sallares 2002:30-31). Angel (1986:760-43) attempted to link porotic hyperostotic skull lesions to malaria, but it is now evident that these lesions may also be caused by a variety of disease processes, for example, haemoglobinopathies associated with chronic anaemia (like thalassaemia and sickle cell anaemia), even iron deficiency anaemia (Sallares 1991:247). Modern immunological tests and DNA sequencing for malarial parasites performed on human remains may, however, produce strong evidence of malarial infection (Sallares 2002:31).

Reliable written records of characteristic periodic fevers will be strongly indicative of malaria, although it must be remembered that other infections such as brucellosis (Brucella abortus) and relapsing fever (Borrelia recurrentis) may also present with intermittent fevers. These diseases occurred in antiquity, but periods of recurrent fever usually last five to nine days unlike the typical one-day fevers of malaria. Intermediate atypical fever patterns may, however, occur in all these diseases (Sallares 2002:10; Kind 1928:836).

**Pre-classical era**

Pharaonic Egypt along the Nile and its delta experienced annual flooding conducive to the breeding of mosquitoes and other insects. Herodotus (2.95)
tells us that in order to escape from swarms of gnats (mosquitoes as such are not specifically mentioned), the Egyptians in the delta lived in elevated dwellings and slept under fishing-nets which kept out the insects. At a later stage, Strabo (17.1.6) and Vitruvius (1.4.11-12) mention that flooding of the Nile in summer cleansed the lakes and marshes of the delta of pestilential disease and made Alexandria a relatively healthy place. We have a significant body of medical papyri describing Egyptian health conditions as far back as the third millennium BC, but there is no good description of intermittent fevers compatible with malaria (Nunn 2002:75). However, Sallares (2002:53-54) suggests that intermittent fever mentioned in the so-called magical papyri may perhaps point at malaria. Immunological tests and DNA sequencing on tissues of mummies dating back to 3200 BC have shown good evidence of P. falciparum malarial infection (Sallares 2002:31). With P. falciparum arising from tropical Africa and migrating north towards the end of glaciation, early infestation of Egypt would appear inevitable (Sallares 2002:28).

Malaria typically shows its maximal incidence during late summer and autumn (Sallares 2002:55-61). Homer refers to the rising of Sirius, the Dog Star (in late summer) as a time of ill health (I. 22.30). In Classical times this connotation of suffering during the 'Dog days' became accepted wisdom as confirmed by writers like Hippocrates (Aër. c. 10), Vergil (Aen. 10.273 ff.), and Tibullus 3.5.1. Autumn (and August) in particular was considered an unhealthy time (Hipp. Aër. c. 10; Caes. BC 3.2; Hor. Ep. 1.7.2 and Juv. 4.55-56), when not only malaria but also other diseases of the hot months, for example, waterborne intestinal disorders, would have been rampant (Sallares 2002:62).

Greek era

The classical descriptions of periodic fevers in the Hippocratic Corpus almost certainly represent the first clear recording of acute malaria (Epid. 1.6-7, 24-26; Aph. 3.21-22; 4.59, 63; Aër. c. 10). Care should be taken not to read too much into terse aphorisms or elaborate descriptions of fevers, but it seems most probable that the seasonal fevers (late summer and autumn) associated with marshy conditions and showing fever peaks (with characteristic rigors, hot and cold spells, and sweating) on every third (tertiary fever) or fourth day (quartan fever) do represent acute malaria. Tertiary fever was said not to be fatal and to abate after the seventh episode of fever; while quartan fever was the least troublesome, but the most chronic and able to cause dropsy. Subtertian fever was considered very serious, but it is not clear precisely what Hippocrates meant by this term. Quotidian (daily) fevers with serious outcome are mentioned, but here it is difficult to decide whether malaria or
other pyrexial illnesses, such as consumption, pertain. Chronic malaria could perhaps be the cause of the weight loss, large spleens and pot bellies said to occur in people who lived in marshy areas and drank stagnant water from the area (Air. c. 7), but these pathological signs could, of course, also arise from other diseases, such as chronic bilharzia occurring in these conditions. Reference to high fatalities among children and women, but not older men (Air. c. 10), would furthermore fit the typical mortality patterns of endemic malaria (vide supra). The fatal disease of Philiscus, who developed delirium, episodic fever and dark urine, is suggestive of cerebral malaria and black water fever (Epid. 1.2.13). Hippocrates also described an association between subterranean fever, consumption and other chronic diseases (Epid. 1.24).

F.E. Kind (1928:842) presented evidence that another prominent physician of the 4th century BC, Diocles of Carystus, also recognised malaria as a disease entity, although the author of the Pseudo-Aristotelian Problemata (7.8) considered fever a disease in its own right. Kind’s suggestion (1928:843) that Aristophanes could have referred to malaria when mentioning an ague in his comedy, The Acharnians (line 1165), is probably far-fetched. Plato (Ti. 86) explained the intermittent fevers on the basis of the humoral theory.

Grmek (1979:141-63) identified the illness which decimated the Athenian army outside Syracuse in 413 BC as probably P. falciparum malaria. He argued that the Syracusan commanders deliberately confined the Athenian forces to an area known to be infested with fever. As a corollary Grmek suggested that P. falciparum malaria was then a new disease to the Athenians who were thus not immune against it. However, Sallares (2002:37) points out that a new subspecies of the parasite in Syracuse could have rendered the Athenians, immune to a local parasite, vulnerable.

A good case can be made for suggesting that Alexander the Great’s death in Babylon in 323 BC was due to malaria, and that he acquired the disease in the marshy regions of lower Mesopotamia (Cilliers & Retief 1999:63-76).

Roman era

Roman endeavours at draining marshes around ancient Rome were largely motivated by public health considerations in view of the recognised association between stagnant water and disease (Sallares 2002:55-61, 71-79). Such diseases would certainly have included malaria, as well as waterborne gastro-intestinal diseases. In warning against building houses near marshes, Columella (1.5) specifically referred to the abundance of mosquitoes in such areas, while Varro (1.7) postulated the presence of minute disease-causing creatures in the marshes which entered the body through the mouth and
nose. Pausanius (7.2.7) referred to the city Myous which had to be abandoned because of mosquitoes from pestilential marshes. Interestingly enough, Vitruvius (1.4.11-12) differentiated between unhealthy marshes and disease-free marshes; the Pontine marshes, he said, were stagnant without significant inflow or outflow, and for that reason pestilential, while the region around Ravenna, Altinum and Aquilea, where the water was salty (preventing breeding of mosquitoes), and Alexandria, where regular Nile floods cleansed the marshes, were disease-free. Strabo (17.1.7 and 5.1.7) similarly compared the healthy marshes surrounding Alexandria with those around Ravenna. Diogenes Laertius (8.70) tells how Empedocles rid the people of Selinus of disease arising from the smelly nearby river by bringing fresh water to the river. The disease which according to Tacitus (Hist. 2.93) ravaged the troops of Vitellius when they carelessly encamped in the notoriously pestilential area near the Tiber, could well have been malaria. He mentions that the foreign Germans and Gauls were particularly affected. When Pliny the Younger (Ep. 5.6) stated that the low-lying coastal regions of Tuscany were unhealthy in summer, this could well have referred to malarial infestation.

In the 1st century the encyclopaedist Celsus (3.3.4.1-3) described commonly occurring periodic fevers which must have been malaria. He mentioned three kinds of intermittent fevers recurring daily (quotidian), every second day (tertian) or every third day (quartan). The tertian fever could be relatively mild when days between fever peaks were apyrexial, or more malignant when the fever never abated completely. The latter was called 'hemitrition' (semi-tertian fever). Fever attacks were accompanied by chills, rigors and perspiration. He furthermore states that quartan fevers were of simpler nature, that combinations of fever patterns could occur and that all these varieties of fever commonly recurred after apparent cure.

Galen included a clear reference to malaria in his De morborum temporibus (K. 7.412). He also described the quotidian, tertian and quartan varieties of fever, stated that quartan fever could last up to two years and cause dropsy, and elaborated on the symptoms of these pyrexial episodes. The patient first experienced a chilling sensation, which evolved into intense shivering, followed by a feeling of great heat, and lastly a phase of profuse perspiration. The intervals between fever episodes were free of these symptoms. Galen writes that these fevers were rife in the Rome of his day and a particular danger to immigrants.

Asclepiades confirmed the high incidence of periodic fevers and stressed the seriousness of quotidian fever which often caused severe cerebral dysfunction (quoted by Caelius Aurelianus, CP 2.63-64).
There is reference to quotidian fever in the writings of Terence (Hec. 357), to probable malarial fever occurring in August in an epistle of Horace (Epi. 1.7.1-9), and to quartan fever (also in August) in Juvenal (4.56). Moreover, Horace (Sat. 2.290) tells of a superstitious mother who promises the gods that she will place her son naked in the Tiber if only he could be cured of his five-months quartan fever. Suetonius (Caes. 1) tells us that Julius Caesar suffered from severe quartan fever while he was hiding from Sulla, and Pliny the Elder (NH 7. 166) refers to the consul Quintus Fabius Maximus who was cured of quartan fever. According to Josephus (BJ 4.8.2; AJ 13.398), summer fevers were rife around the Sea of Tiberias and the Jordan valley, and quartan fever probably hastened the death of the Jewish King Alexander Jannaeus. Martial (10.77) considered it a cruel turn of fate that Carus, a specialist in quartan fevers, should eventually die of the disease. He also refers to his friend, Maro, who was seriously ill with semitertian fever (12.90). Perhaps the best description of a malarial case comes from Cicero's letters to Atticus (Att. 123.1; 124.1; 125.2; 128.1, 3, 5; 130.3; 131.2; 154.4; 168; 171.1; 173.3; 175.2; 200.3; 207; 208), who acquired quartan malaria in September 50 BC. By November he apparently had serious fever, and in December his wife, Pilia, contracted the same disease. By February 49 BC Atticus was cured. In March he suffered a recurrence of quartan fever; but by May both husband and wife were well. More than two centuries later, Galen diagnosed quartan fever in the Peripatetic philosopher, Eudemus (Progn. K. 14.607-14, 619, 624).

It may be inferred that malaria also infested the rest of Europe in Roman times, although the cold-sensitive P. falciparum was less likely to survive in these colder regions than P. vivax and P. malariae (Sallares 1991:273-74). The consul Fabius Maximus (vide supra) acquired malaria while fighting German troops in 121 BC. A tombstone inscription from Hibitancum in Britain reads: 'Ael(i a) Thimothea - a dedication to the goddess of tertian fevers' (Kind 1928:846). However, the remark by Caesar (BC 3.2) that Gaul and Spain were much healthier in autumn than Italy could be interpreted as indicating that those regions were less malarious. Strabo (5.2.7.225) stated that the island of Sardinia was unhealthy in summer, especially in the fertile regions, and that this hampered military operations. Sallares (2002:92-93) assumes that this indicated malarial infestation, but factual evidence from ancient sources is inconclusive.

Burke (1993:2259-60) mentions various factors which could support this view, namely the large-scale grain agriculture introduced by the Carthaginians after their invasion of Sardinia in the mid-sixth century BC. This led to widespread deforestation, followed by flooding and the formation of swamps in the lowlands which would form an ideal breeding-ground for
mosquitoes. However, the fact that ancient writers who referred to the unhealthy reputation of the island did not specifically mention repeated tertian and quartan fevers, leaves us with inconclusive evidence.

Treatment of these fevers is discussed by various writers. Pliny the Elder (NH 30.98) recognised that there was no effective herbal remedy for quartan fever in particular and proposed a series of magical treatments. The long list of remedies suggested by him and other authors demonstrate the difficulty experienced by the ancients in treating malaria. He quoted an unknown doctor, Ictocidas, who claimed that sexual intercourse with women beginning to menstruate cured quartan fever (NH 28.23 and 63). He also noted the suggestion by Quintus Serranus that bedbugs should be eaten with eggs and wine, but did not approve of it (NH 29.17.63). Celsus reviewed existing remedies, claiming that death often followed wrong treatment, but at the same time recommended venesection early in the disease (De medicina 3.4; cf. Sallares 2002:15). Cato (RR 157.7) denounced all Greek medical treatment as worthless, and treated splenomegaly (a common sign of chronic malaria, but also sometimes present in the acute phase) with cabbage.

Discussion

Descriptions in antiquity of quotidian, tertian and quartan fevers agree closely with modern concepts of malarial disease. Quotidian fever does occur in P. falciparum infection and Hippocrates (Epid. 1.6-7) and Asclepiades described it as a potentially fatal illness (quoted by Caelius Aurelianus, CP 2.63-64). However, both Celsus (3.3.3) and Hippocrates (Epid. 1.6-7) recognised that quotidian fever represented a wide variety of conditions. Today we know that the quotidian fever of antiquity probably included many pyrexial illnesses besides malaria. The benign tertian fever recognised by Hippocrates (Epid. 1.24) and Celsus (3.3.2) would correspond with P. vivax infection, and the very common and benign but chronic quartan fever mentioned by many writers almost certainly represented P. malariae infection. Dropsy as complication of quartan fever is mentioned by Hippocrates (Aër. c. 7) and Galen in De morborum temporibus (K. 7.470) and almost certainly points at the nephrotic syndrome known to arise from chronic P. malariae infection. The very serious semi-tertian (sub-tertian) fever recognised by Hippocrates (Epid. 1.2.13), Celsus (3.3.4.1-3) and others would fit today’s malignant tertian malaria, caused by P. falciparum. The fatal disease of Philiscus described in the Hippocratic treatise Epidemics (1.2.13) could well be history’s first reported case of cerebral malaria and blackwater fever, both complications of P. falciparum disease. According to Caelius Aurelianus, Asclepiades also referred to a serious cerebral disease which could follow on quotidian fever (CP 2.63-
Hippocrates' observation that endemic malaria affected mostly children and pregnant women is confirmed by modern epidemiology (Air c. 10). When the Stoic philosopher Favorinus eulogised quartan fever, he quoted Plato and referred to the common belief among ancients that this condition terminated other fevers and left you a healthier person (quoted by Aulus Gellius 17.12). There is no clear modern explanation for this observation, but it is very interesting to note that until 40 years ago deliberate (controlled) infection with P. vivax was accepted therapy for forms of chronic neurological syphilis (Brain et al. 1969:419).

Sallares (2002:13-22, 31-42) produces convincing evidence that all forms of malaria (except P. ovale infection) were present in the Mediterranean area in the Classical era. The ancients were, however, vague about the etiology of this disease. Columella (1.5.6) stated that doctors did not understand the cause of fevers. The seasonal incidence with maximal disease in later summer and autumn was recognised – the months of August and September were particularly unhealthy, as was the time after the rising of Sirius, the Dog Star. 'Do not go near the pool around the dog-time of summer', Tibullus warned (3.5-1-3). There was general acceptance of the fact that fever was associated with marshes and stagnant water, and Pausanius (7.7.) and Columella (1.5.6) mentioned the abundance of mosquitoes in these areas. Disease was, however, ascribed to miasmic factors – toxic vapours rising from the water to cause illness (Sallares 2002:45-46.). Varro (11.12) and Columella (1.5.6) talked of minute creatures emanating from marshes and entering humans through their mouths and noses to cause disease. Herodotus (2.95) described techniques used by the Egyptians to avoid insect bites in marshy areas, and Pliny (NH 20.71.184; 22.74.157.) recommended Roman coriander and other plants to dispel mosquitoes, but the Mediterranean people did not grasp the causative association between mosquito bites and intermittent fevers (malaria) (Sallares 2002:47-49). Indeed, the Greeks barely differentiated between mosquitoes and gnats (Sallares 1991:272). In this respect the ancient Greeks and Romans lagged behind their Chinese contemporaries who recorded the fact that fevers were caused by mosquito bites as early as the 8th to 5th centuries BC (Sallares 2002:49). Intermittent fevers were explained according to humoral theories of the time, Plato stating that excess air caused quotidian fevers, excess water tertian fevers and excess earth quartan fevers (Pl. 44). Kind (1928:833) quotes Galen's extensive theories on how disturbances of bodily humours could produce the excess heat necessary for fever attacks. The symptom, fever, was considered a disease in its own right by Pseudo-Aristotle (Problemata 7.8). There was also a strong belief that fever was of divine origin: in Rome a temple was dedicated to the goddess of fever.
Malaria is thus an ancient disease which was endemic in classical Greece and Rome, and scholars have debated its impact on the ancient civilisations. Jones’ original theory that malaria was a decisive factor in the decline of Greek civilisation is no longer entertained by classicists such as Sallares (1991:278-79). However, in view of its undoubted effect as an agent of natural selection, it might still have had an impact on a population. It is known, for instance, that certain haemoglobin abnormalities occurring in the Mediterranean basin (for example, thalassaemia, sickle cell disease, the Duffy blood group, and deficiency of the enzyme G6PD) protect against malaria; carriers of these characteristics would thus increase in numbers in malarial areas (Sallares 1991:279). Similarly Kind (1928:846) has posed the question whether malaria was a pertinent factor in the decline of Rome where it certainly was a major health hazard. It is not the aim of this study to discuss this extensive issue, but it would be relevant to note Sallares’ considered opinion (2002:115-23) that such an hypothesis is not supported by available evidence.

Bibliography


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