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An occurrence of avian malaria in domestic pigeons in Tamil Nadu, India

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Abstract

Plasmodium relictum is an invasive blood protozoan, which causes malaria in various species of birds worldwide and often leads to heavy mortality in naive birds. The aim of this study is to report the occurrence of *P. relictum* in the domestic pigeons with flock size of 150 birds and its gross pathological features in the various organs of the affected birds. Postmortem changes in dead birds showed enlargement and discoloration of the liver, serofibrinous pericarditis, hazy air sacs and swollen congested Kidneys. Organ impressions revealed various stages of *P. relictum*. This study concludes the first report of occurrence of *P. relictum* in domestic pigeons of Tamil Nadu.

Keywords: avian malaria, *Plasmodium*, pigeon, parasites, postmortem

Introduction

Plasmodium relictum affects a wide range of domestic and wild birds. It is an invasive haemoprotozoan parasite, which causes malaria in various species of birds worldwide [1]. Severe malarial infection often occurs in naive birds and even to the extent of mortality [2]. The parasites are easily distinguishable in blood films because of its distinct morphological characteristics. Mature stages typically have predominant nuclei and cytoplasm with numerous pigment granules. Microscopic examination of blood films is the main universal diagnostic tool. The domestic pigeon, *Columba livia domestica* belongs to the avian family, Columbidae. The prevalence and intensity of haemoparasites in columbids have been reported [3]. Infections of pigeons by overabundance of blood parasites impair successful breeding of these birds resulting in heavy economic losses manifested by lowered resistance to other infectious agents, general ill health, reduced feed conversion efficiency, weight loss, stunted growth, and sometimes death if untreated [4]. They can also serve as a source for different zoonotic diseases for humans and birds. The knowledge on diversity and prevalence of pigeon blood parasites is quintessential for effective management. Helminth parasitic fauna of columbids have been studied in recent past [5, 6]. But, the works related to blood protozoan parasites of domestic pigeons and its pathologic features are scarce. Hence, the aim of this article is to report the occurrence of *P. relictum* in the domestic pigeons with flock size of 150 and its gross pathological features in the various organs of the affected birds.

Materials and Methods

A flock consisting of 75 pairs of pigeons maintained in a private farm located at Maduravoyal, Chennai, Tamil Nadu, and India. They were maintained in a wire mesh cages separately in pairs with proper ventilation and protection from sunlight and rain. They were fed with overnight soaked grains (millets), chickpea and wheat, supplied with *ad libitum* water in a basin for drinking. The birds were allowed for free flight in the morning and evening time for an hour.

Amongst the 75 pairs of pigeons, 22 pairs were suddenly dull and went off feed, weight loss, ruffled feathers, increased body temperature and start dying one by one. Mortality reached upto 50% in the affected flock in a day or two. Post-mortem was conducted in 4 dead pigeons and the gross lesions were recorded and photographed. Impressions from liver, kidney and spleen were taken and stained with Leishman-Geimsa stain and observed under microscope.

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Results and Discussion

Pathology

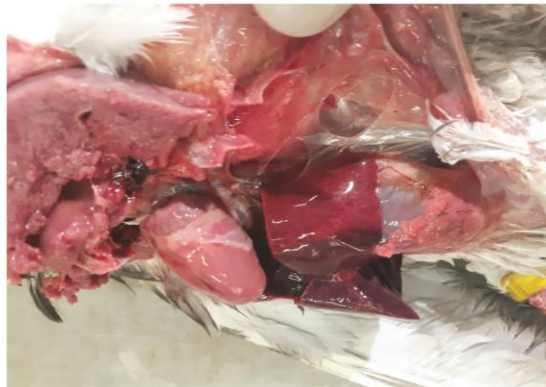
Affected pigeons were dull and depressed, increased body temperature, ruffled feathers, watery secretion from the eye, sunken eye ball and died one by one and reached 50% mortality (Plate 1a). When the abdominal cavity is opened, enlargement and discoloration of the liver (arrow) is immediately apparent. Serofibrinous covering over pericardium, hazy and white air sacs, Liver was congested,

enlarged and mottled with speckled and granular in appearance. Both the liver and spleen increased dramatically in size and darkly discoloured. (Plate 1b-d). Kidney was congested and swollen in affected bird (Plate 1e). Intestinal mucosa was thickened and congested. Intestinal content was catarrhal and thick in nature (Plate 1f). Liver impression revealed *Plasmodium relictum* schizonts in RBC (Plate 2a), macrogametocytes in RBC (Plate 2b), microgametocytes (Plate 2c) and trophozoites in RBC (Plate 2d).

Plate 1



a. Pigeon affected with *P. relictum*



b. Serofibrinous covering over pericardium, hazy and white air sacs, congested, enlarged and mottled liver with with speckled and granular in appearance



c. Serofibrinous covering over pericardium, hazy and white air sacs, congested, enlarged and mottled liver with with speckled and granular in appearance



d. congested and enlarged liver with serofibrinous cloudy fibrinous membrane covering



e. congested and swollen kidney of affected bird



f. Severely congested mucosa with cattarrhal enteritis of affected bird

Plasmodium species was characterized by rounded schizonts and elongated microgametocyte (7.8 x 7.6µm) and macrogametocyte (7.8 x 7.7 µm) with irregular margins. Cells containing schizonts are often rounded and enlarged (Plate 2a) and those parasitized by gametocytes may be somewhat distorted in shape by lateral hypertrophy (Plate 2b-c). Host cell nuclei are also displaced [7].

Trophozoites

The smallest parasites (1.5 x 1.5 µm) have no visible cytoplasm, vacuole or pigments. A thin gray cytoplasm visible in 2.7 x 2.7 µm sized trophozoites which lacked pigment. Uninucleate parasites usually elongate, but as they approach the first nuclear division, often become rounded or oval (Plate 2d). As they grow, some of them appear to migrate to the polar end of the host cell where they often assume characteristic U-shape, bending about the end of the erythrocyte nucleus. No nuclear displacement of the host cell due to trophozoites was evident [7].

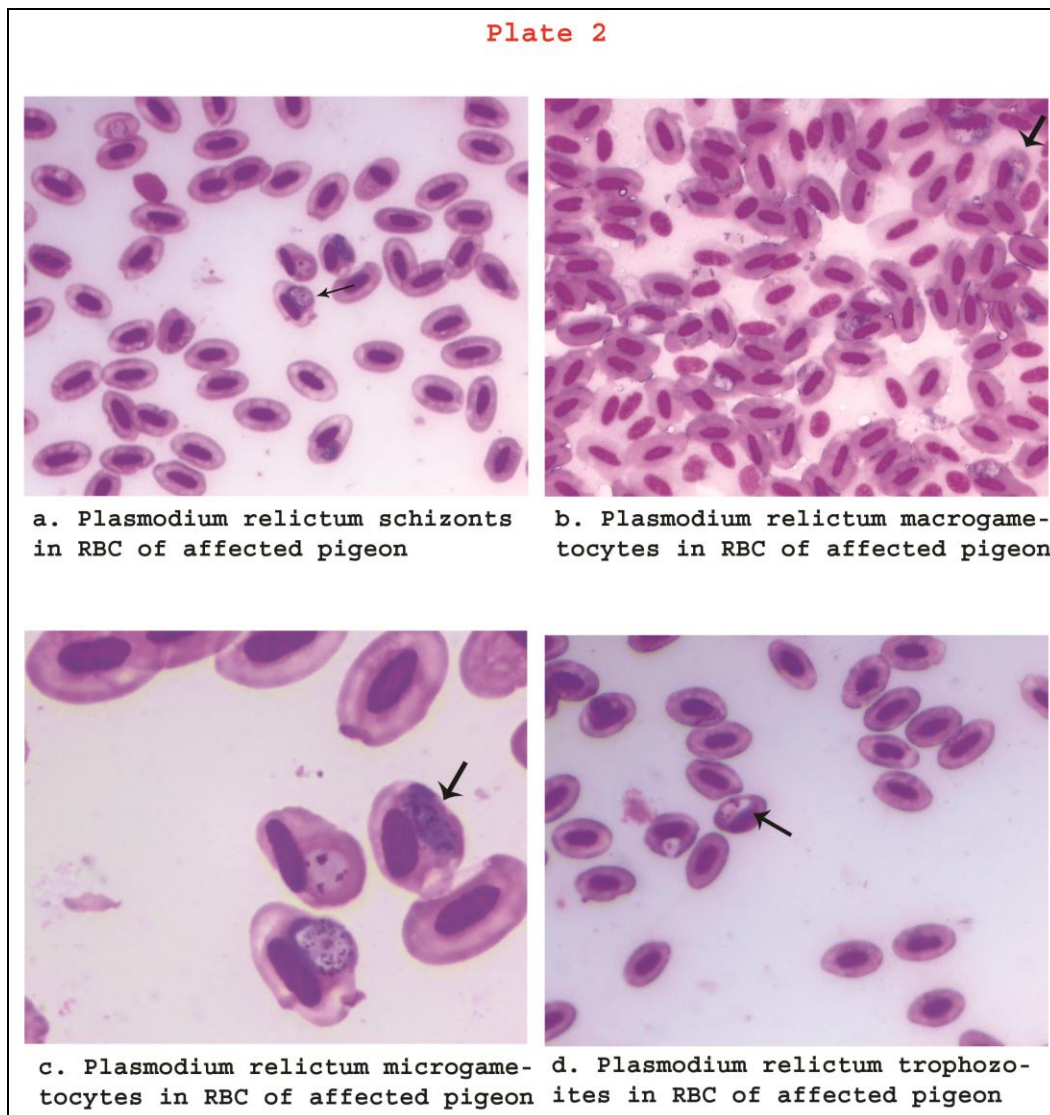
Schizonts

Schizonts usually lateral to the host cell nucleus, always

marginal and visible in various stages of development: early schizont, rosette shaped schizont and mature schizont. They changed the shape of the infected erythrocyte and displace the host cell nucleus towards one side. Pigments usually found in clumps and are more conspicuous at the extremities of the parasite. Schizonts were 5.9 x 4.1 µm in size and their nuclei usually distributed in the form of a rosette [7].

Gametocytes

Stained mature gametocytes showed characteristic sexual differences, macrogametocytes stained blue and microgametocytes appeared pink or white in colour. Gametocytes appeared oval or round when occurring in a polar position in the cell and sometimes the host cell nucleus was oblique in position. Mature gametocytes can fill the entire host cell cytoplasm. Pigment granules were small, dispersed and vary greatly in number in macrogametocytes whereas in microgametocytes, they clustered at one end of the parasite. Macrogametocytes averaged 7.8 x 7.7 µm and microgametocytes 7.8 x 7.6 µm in size [7].



Plasmodium is universal among wild birds. Their form and morphology is relatively well known globally and in India. Erythrocytic stages of *Plasmodium* from the blood of wild populations have been reported by various workers [8].

The shape of gametocyte (round or oval shaped) indicates a closer morphological similarity to *P. relictum* [9]. The larger trophozoites and schizonts are especially characteristic of the *P. relictum* [10]. Golden brown or black pigment granules are

produced as a by-product of haemoglobin digestion and are usually not visible in young trophozoites. Multinucleated meront (or schizont) of *Plasmodium relictum* in erythrocyte appeared as red, grape-like nuclei surround a central residual mass of pigment^[11]. Mature macrogametocyte (female) and microgametocytes (male) in erythrocytes develop from merozoites and are infectious to mosquitoes. Macrogametocytes typically stain dark blue and have a single, small compact central nucleus and a number of pigment granules^[12]. Gametocytes are typically round or oval and exceed the size of the host cell nucleus. The host cell nucleus is usually displaced to one side of the erythrocyte and may be partially or completely turned^[13]. Changing in the prevalence, geographic location and host are associated with the habitat preference of the birds, the abundance and feeding habits within the habitats of appropriate vectors and inherent physiological variations make avian hosts more vulnerable than others^[14].

Conclusion

The occurrence of *P. relictum* in the domestic pigeons with flock size of 150 birds and its gross pathological features in the various organs of the affected birds has been reported. Postmortem changes in dead birds showed enlargement and discoloration of the liver, serofibrinous pericarditis, hazy air sacs and swollen congested Kidneys. This study concludes the first report of occurrence of *P. relictum* in domestic pigeons of Tamil Nadu.

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