OESOPHAGOSTOMIASIS, A COMMON INFECTION OF MAN IN
NORTHERN TOGO AND GHANA

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Abstract. Infection with Oesophagostomum sp. is normally considered a rare zoonosis
and up to this time its diagnosis has been based on the demonstration of larvae and young
adult worms in the typical nodules formed in the intestinal wall. Only in Dapaong, in
North Togo, and Bawku, North Ghana, have larger series of clinical cases been described.
In the rural areas around these towns, a survey was made in which stool samples were
collected and cultured. Third-stage larvae of Oesophagostomum sp. could be found after
5—7 days of incubation at room temperature, and the prevalence of infection with this
parasite was often high but varied from one village to another. It was over 30% in seven
villages out of the 15 villages surveyed. Anthelmintic treatment resulted in the evacuation
of adult males and females of O. bifurcum. It is concluded that O. bifurcum is a locally
common parasite of humans, not requiring an animal reservoir for completion of its
lifecycle.

In 1911, four years before his famous articles
on schistosomiasis in Egypt appeared, Leiper
wrote a short article which started as follows:1

"Andrew Foy, of West African medical staff, was
good enough whilst on home leave to present to
the London School of Tropical Medicine a tube
containing a considerable number of species of
Necator americanus, passed by a patient at Ibi,
Northern Nigeria. In the course of routine ex
amination of individual specimens, I have been
able to single out six examples of Oesophagos
tomum apiostomum . . . .".

And further: "The specimens resemble N.
amERICANUS very closely and would probably have
been overlooked had they not been scrutinized
with a hand lens".

The first report on oesophagostomiasis in hu
mans dates from 1905 when Railliet and Henry
described the parasites obtained by Brumpt from
tumors of caecum and colon of "a native on the
river Omo" in Southern Ethiopia.2 A very careful
description of the macroscopical and microscopical
pathology was given in 1910 by Wolfertstan
Thomas on material from a similar case ob
served during the Amazon expedition of 1905-1909.3

The adult worms described by Leiper were not
only the first adult oesophagostomes described
in humans, they were almost the last ones as well.
On 3 April 1913 Dr. W.B. Johnson, Medical
Officer in Zunguru, Nigeria, and a colleague of
Dr. Foy, sent a report to London on the "En
tozoal Infection Amongst Prisoners": upon stool
examination of 200 prisoners eight appeared to
be infected with oesophagostomes.4 Johnson ad
ministered thymol and eucalyptus to his patients
to remove hookworms; apparently, he found oe
sophagostomes as well. Thereafter, in 1920,
Henry and Joyeux briefly mention that in 1910
or 1911 they once found adult specimens of Oe
sophagostomum brumpti in a stool specimen ob
tained after anthelminthic treatment for hook
worm infection in French Guinea.5 No other
reports of adult worms in humans could be found.

Immature worms, on the other hand, have been
found in humans from time to time and have
been attributed to a variety of species (O. brump
ti, O. stephanostomum var thomasi, O. apiostos
tum, O. aculeatum and O. bifurcum). The im
mature worms are found in nodules and tumors
in surgical material from clinical cases. In total
some 15 original and reliable publications on
human infections are known to us. Clearly, these
cases are also fairly rare and by most authors
humans are believed to be an abnormal host.
Elmes and McAdam, for instance, in 1954 and
Chabaud and Lariviere in 1958 stress the point:
young adult worms which should have entered
the intestinal lumen were still found in the nod
ules and were believed not to reach the egg-pro
ducing stage.6 7 Haaf and van Soest, in 1964,
described nine cases at Bawku Hospital in nor
thern Ghana and concluded that the species they
found which was supposed to be Oesophagos-
Oesophagostomiasis in man

*Oesophagostomum bifurcum*, was considered unlikely to have an animal reservoir: human contact with the most obvious reservoir, monkeys, in the area "does not seem sufficient to maintain the infection in man", whereas ruminants are common hosts for other oesophagostomes but not for *O. bifurcum*. They concluded that "the possibility that man himself may act as a source of infection, cannot yet be discarded". However, repeated attempts to culture larvae from stool specimens from patients in whom worms were found failed.

In 1987, Gigase and others reported on a large number of clinical cases of oesophagostomiasis originating from nearby Dapaong in northern Togo: "During 1980 and 1984, 51 patients with unusual large and/or painful abdominal tumours, signs of intestinal obstruction or abscesses of the bowel were operated upon at the regional hospital in Dapaong, North West Togo". Some of the nodules were empty, suggesting that the developing larvae or young adults might have entered the intestinal lumen. If so, adult worms could be present in the bowel and eggs would be excreted with the human feces.

The eggs of *Oesophagostomum* of monkeys are very similar to hookworm eggs excreted by humans: those of *O. bifurcum* are reported to be 51–72 μm long and 29–40 μm wide; those of *O. aculeatum* are said to be 64–80 μm long and 32–42 μm wide. They probably cannot be differentiated morphologically from those of hookworms, and culture methods have to be used to demonstrate the development of characteristic larvae. Until now, only Haaf and van Soest and Leoutsakos and others made mention of the use of culture methods, but both failed to find *Oesophagostomum* larvae.

The principal objectives of the present study were, therefore, to establish whether adult egg-laying oesophagostomes can be found in the intestinal lumen of humans and if so, of what species. Can the infection be diagnosed by fecal culture? How common is the infection and what is the route of transmission?

**MATERIALS AND METHODS**

The study area is typical of the Guinea Savanne; there is one long rainy season from June to September and it is hot and dry thereafter.
Houses are scattered over the farm lands and the "villages" examined are in fact ill-defined agricultural areas with a rather dense population. The most important tribes are the Moba and the Gourma; Peul tribesmen from the north are a minority. Hookworms are common (prevalence > 50%) but *Ascaris lumbricoides* and *Trichuris trichiura* are rare parasites.

Stool cultures were performed using a modification of the classical charcoal culture procedure. A quantity of 1—3 grams of feces, mixed with an equal quantity of coarsely ground charcoal is placed on moist filterpaper in a petri dish and incubated for seven days at room temperature (25—35°C). The water is poured off and centrifuged; the sediment is examined at low power (4 × 10) for the presence of larvae.

The definitive diagnosis of human infection with *Oesophagostomum* and the determination of the species involved, could only be made reliably after recovery of the adults themselves from the intestinal lumen. To this end, patients in whose stool cultures characteristic larvae were found were treated with pyrantel pamoate (10 mg/kg) or albendazole (one single dose of 400 mg). All feces were collected during 48 hours after treatment and sieved over a number of wire mesh sieves with pore sizes from 1000—100 μm. The worms obtained were examined both by light and scanning electron microscopy.

To determine the prevalence and distribution of infection with *O. bifurcum*, surveys were performed in which stool specimens were cultured from inhabitants from a number of communities in northern Togo and Ghana. No attempts have been made, as yet, to examine truly random samples of the local populations. Instead, the surveys were limited to examination of visitors to mother and child clinics, to the outpatients of the dispensaries and to those who presented voluntarily when the field surveys were carried out. We attempted to examine equal numbers of males and females of different ages. No less than 50 persons were examined in each village.

RESULTS

*Oesophagostomum*-like larvae were cultured from stool samples with "hookworm eggs", even though the samples were obtained from patients without apparent symptoms. The morphologic characteristics of the larvae involved are shown in Figure 1. They average 828 μm long (748—950) and 29 μm wide (26—42). The sheath shows...
FIGURE 3. Scanning electron micrograph of the cephalic end of a female *O. bifurcum* recovered from human feces. Note the inner and outer leafcrowns with 12 and 24 (sometimes 10 and 20) lips respectively, and the papillae. The photo was made by the Department of Electron Microscopy, Medical Faculty, Leiden University. Magnification: 1,000×.

a prominent transverse striation and the posterior end is tapering to a long and threadlike tip. In larvae freshly collected from fecal cultures, 16–30 triangular intestinal cells are often clearly visible. Using Little's key, the larvae will be recognized as larvae of *Oesophagostomum sp.*

Treatment of patients excreting "hookworm eggs" and examination of the stools the days after treatment yielded adult specimens of both *Oesophagostomum sp.* and *Necator americanus*. Third-stage larvae obtained from eggs that were removed from the uterus of these adult oesophagostomes were morphologically identical to those obtained from the stool cultures. Details of the adult oesophagostomes recovered are given in Figures 2–4. The mean length of the females (n = 30) was 13.0 mm (11.0–16.8 mm); the males (n = 20) were smaller: 10.4 mm (8.2–13.1). The cephalic groove (Fig. 2) and the shape and orientation of the rays of the male's bursa (Fig. 4) are characteristic of the genus. The dimensions along with the shape of the buccal cavity, and the details of the external and internal leafcrowns with 10–12 and 20–24 leaves respectively, are compatible with the species *O. bifurcum*. The length of the spicules (842–1113 (μ)m; n = 20) is considered to be characteristic of the species.

The age- and sex-specific prevalence of infection is given in Table 1. The location of the villages involved and the prevalences of infection in subjects older than five years of age, are given in Figure 5. In each of the villages more than 50 persons were examined.

Discussions with older health workers in Dapaong made clear that the disease that may be caused by the infection was well known to the local people. It is known that the "Tumeur de Dapaong" (Figure 6) may burst open either to the intestinal lumen or the abdominal wall. In one of the local languages (Moba), such a mass was referred to as "Koulkoul", which means...
FIGURE 4. The bursa of a male. The shape and orientation of the rays is characteristic for the genus. Magnification: 190 x.

"having a turtle in your belly", and in another (Gourma) as "TougnaLE", which stands for "abcess in the abdomen". Traditionally, the patients were treated by the application of heat until the abcess burst.

DISCUSSION

It is quite remarkable that human infections with *Oesophagostomum* *sp.*, up to this time believed to be rare zoonotic accidents, could not only be proven to occur, with the use of classical, almost antique methods, but also that they appeared to be very common indeed in the study area of North Togo and Ghana. Previously, the eggs found in human feces were indiscriminately, and erroneously, referred to as hookworm eggs, whereas in this study area they appear to be a mixture of hookworm and *Oesophagostomum* eggs. To the local population, in contrast, the clinical expression of the disease is not new, but their acquaintance with this disease faded with

<table>
<thead>
<tr>
<th>Age (yrs)</th>
<th>Males</th>
<th></th>
<th>Females</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>+ve</td>
<td>%</td>
<td>n</td>
</tr>
<tr>
<td>0–4</td>
<td>426</td>
<td>21</td>
<td>(4.9%)</td>
<td>416</td>
</tr>
<tr>
<td>5–9</td>
<td>358</td>
<td>70</td>
<td>(19.6%)</td>
<td>305</td>
</tr>
<tr>
<td>10–19</td>
<td>332</td>
<td>71</td>
<td>(21.4%)</td>
<td>308</td>
</tr>
<tr>
<td>20–29</td>
<td>169</td>
<td>20</td>
<td>(11.8%)</td>
<td>351</td>
</tr>
<tr>
<td>30–39</td>
<td>125</td>
<td>14</td>
<td>(11.2%)</td>
<td>230</td>
</tr>
<tr>
<td>≥40</td>
<td>115</td>
<td>21</td>
<td>(18.3%)</td>
<td>107</td>
</tr>
<tr>
<td>Total</td>
<td>1,525</td>
<td>217</td>
<td>(14.2%)</td>
<td>1,717</td>
</tr>
</tbody>
</table>
OESOPHAGOSTOMIASIS IN MAN

FIGURE 5. Sketch map of the northern parts of Ghana and Togo. The figure shows the prevalence of the infection with Oesophagostomum in those localities where more than 50 persons (age 5 years and over) have been examined.

The introduction of modern western health care facilities, some 40 years ago.

Both male and female adult worms were recovered in subjects in whose stool specimens third-stage larvae resembling those of Oesophagostomum, had been found. The presence of adult worms in the intestinal lumen, in combination with the finding of eggs which could be cultured into characteristic third-stage larvae of Oesophagostomum spec., confirms that the life cycle is completed in humans. Monkeys, previously believed to be the reservoir of the infection, are rare on the Togolese side of the border. They are not an essential link for transmission.

The taxonomic status of oesophagostomes has given rise to much confusion. Chabaud and Lariviere's overview of the synonyms illustrates the point.7 Specimens once described as O. apios:tomum are now classified as either O. bifurcum or O. aculeatum. Moreover, the descriptions of several species are sometimes incomplete or based on very few specimens. O. bifurcum and O. brumpti are considered synonyms by Chabaud and Lariviere, but they are split by the more recent study of Glen and Brooks, even though only two specimens of the latter species have been properly described.7,14 The body length of the females (11.0–16.8 mm) found in our study is too long for O. bifurcum according to Glen and Brooks, and would instead be within the limits of O. aculeatum. The latter species, however, is thought to be confined to Asia. Moreover, the dimensions of the worms may well be host-dependent, as pointed out by Chabaud and Lariviere. In conclusion, the worms recovered in the present study are provisionally classified as O. bifurcum. A full description of a large number of the adult worms and the larval stages is in progress.

The method of culturing stools results in the frequent detection of infection with Oesophagostomum in this area. In most cases small numbers of Oesophagostomum larvae were found, although sometimes several hundreds could be
counted in a culture. It is probable that many
light infections have escaped diagnosis and thus
the true prevalence is considerably higher than
reported. A detailed analysis of the sensitivity
and reproducibility of the diagnostic method is
in progress.

The figures showing geographical distribution
and the age- and sex-specific distribution demon-
strate that the prevalence varies from 0% to
over 50%. The highest prevalences are found in
the rural villages, most distant from the main
roads. Lower prevalences are seen in the regional
centers of Bawku and Dapaong, and in the near-
by communities along the principal roads. The
prevalence is higher in females than in males and
comparatively low in children under the age of
five. Even though very young children are less
infected, it is remarkable that at the age of about
10 a high prevalence may already be seen. Ap-
parently transmission can be quite intense. The
route of infection, however, remains obscure.
Animal oesophagostomes, like *O. colombianum*
in sheep, are mostly contracted orally, while
grazing. In parallel, it might be assumed that
for humans too, oral infection is the most likely
route of transmission.

Understanding the epidemiology of oesopha-
gostome infections in this area is not only fas-
cinating but relevant for the local population and
its health care. The frequency of cases operated
upon, as described by Gigase and others and the
existence of local names to describe the clinical
disease, reflect the importance of the infection.9
The clinical manifestations were often quite im-
pressive in Gigase’s series: in 16 patients of this
series, the masses were described as “enormous”
or “very big”. In nine cases the patients pre-
sented because of the “disfiguring dimensions”
of the masses or for “esthetic reasons”. While
the prevalence of infection was shown to be com-
paratively low in children under five, 22% of the
surgical cases of Gigase and others were young

| Table 2 |
| Frequency of symptoms per age group as seen in the series of surgical cases described by Gigase and others, 1987 |

<table>
<thead>
<tr>
<th>Symptoms</th>
<th>&lt;5</th>
<th>5-19</th>
<th>≥20</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intestinal obstruction</td>
<td>3</td>
<td>6</td>
<td>4</td>
<td>13</td>
</tr>
<tr>
<td>Painful abdominal mass</td>
<td>2</td>
<td>10</td>
<td>5</td>
<td>17</td>
</tr>
<tr>
<td>Painless abdominal mass</td>
<td>4</td>
<td>11</td>
<td>4</td>
<td>19</td>
</tr>
<tr>
<td>Others</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>2</td>
</tr>
</tbody>
</table>
children (Table 2). Painless abdominal masses will show more readily in young children but also the most serious complication, intestinal obstruction due to extensive adhesions around the intestinal nodules, is rather frequent in the youngest age group. The discrepancy between surgical and epidemiological observations can only be speculated upon.

One of the most fascinating questions is why this infection is so common in the study area while it is not recognized elsewhere. Is it due to a gross underreporting of clinical cases and inadequate diagnostic routines in other parts of Togo and neighboring countries, or is the distribution of the infection limited to this area? The first explanation undoubtedly plays a role, but there are reasons to believe that the second one, too, is true to some extent. It is the clinical experience of one of us (S.B.) that patients with a "tumeur de Dapaong" are never seen in the south of Togo. Moreover, it is remarkable that the two foci from which series of clinical cases have been described independently, Bawku and Dapaong, are situated in different countries, but at a very close distance of some 50 kilometers. From no other country have more than a few isolated cases ever been described. Clearly, more extensive surveillance will be necessary to determine the geographic distribution of this parasitic infection in humans.

Finally, both pyrantel pamoate and albendazole have been shown to be capable of removing adult oesophagostomes from the intestinal lumen. The efficacy of these drugs, as well as the need to use them, has to be further analyzed before a policy on treatment of infected persons can be formulated.

It can be concluded that the results presented in this paper provoke a number of questions on the taxonomy, the sensitivity and reproducibility of diagnosis, transmission, natural course of infection, efficacy of treatment and ways to deal with this previously unrecognized parasitic infection of humans. Studies on these aspects are ongoing.

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