suggestion is justifiable pending microscopical or biochemical evidence.

Treatment of the amblyopic patients has been undertaken by Major R. H. Girdwood, R.A.M.C. In addition to a full European diet supplementary vitamins are administered. Each man receives ten tablets of "Multivite," a preparation containing thiamin 1 mg., riboflavine 1 mg., ascorbic acid 25 mg. and nicotinic acid amide 10 mg., together with aneurin 6 mgs. daily, and at the start parenteral vitamins in the form of 8 c.c. of crude liver intramuscularly for 6 days. Severe cases also receive parenteral riboflavine which is in short supply. Yeast is not locally obtainable.

Amblyopic patients are still arriving at the rate of about 5 per day, and it would be serious if 1 per cent., and may be more, of the survivors from Japanese prison camps are to be permanently disabled by defective sight. So far there has been insufficient time to assess improvement, though after a fortnight about half the patients consider that they can see better especially when trying to read. In some cases acuity has improved by as much as two lines of the test type and in several the density of the scotoma is reduced. Some men in the early stages recovered during captivity when better food was supplied and it is to be hoped that even at this late stage all will improve to some degree in the course of months. Presumably those with established optic atrophy are the least favourable. Arrangements have been made to follow up all the cases, British, Australian and Dutch, and it is hoped to publish a full report at a later date.

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OCULAR GNATHOSTOMIASIS*

BY

K. SEN

HONORARY SURGEON, EYE INFIRMARY, MEDICAL
COLLEGE HOSPITALS, CALCUTTA

and

N. GHOSE

OFF. HOUSE SURGEON, EYE INFIRMARY, CALCUTTA

PARASITES in the human eye are rare. Onchocerca is responsible for cases of blindness in certain regions of Africa and America. Undoubted cases of filaria bancrofti, doubtful cases of filaria loa

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(*F. oculi*), and *filaria medinensis* have been described. *Cysticercus cellulosae*, *echinococcus*, the *lazia callipaeda* and larvae of flies have been reported. This is probably the first case of *Gnathostoma* in the human eye to be reported. Human infection with *Gnathostoma* is very rare. According to Maplestone and Bhaduri (1937) since the report of the first case of human infection in Siam in 1890, only 24 definite and 60 clinical cases were reported up to 1937. These cases were distributed as follows, 15 definite and 60 clinical cases from Siam, one from Malaya State, three from China, one from Japan and four from Bengal. The sites from which the worm had been recovered in the four cases recorded from Bengal were two from superficial abscesses in fingertips, one from a mastoid abscess and one from an abscess on the right side of the forehead. The other reported sites in which the worm had been found were the subcutaneous tissues and internal organs, *e.g.*, stomach, lungs and kidney. The following brief description of the worm, its life cycle and habitat has been taken from Faust (1939).

***Gnathostoma spinigerum*, Owen, 1836**

It is a nematode of the superfamily Spiruroidea, Railliet and Henry (1915), and family Gnathostomatidae, R. Blanchard (1895). The synonyms are *Cheiracanthus*, Diesing (1836), *Cheiracanthus siamensis*, Levinsen (1890), *Gnathostoma siamense* (Levinsen), Railliet (1893). This worm was first recovered from the stomach nodule of a tiger by Owen in 1836. Since then it had been recovered from the stomach nodules of domestic cats, wild cats, leopards and dogs and oesophageal nodules in weasels in Malaya States, China, India and Japan. The first human infection was reported by Levinsen in 1890, when he studied a single immature worm obtained by Deuntzer from a breast abscess of a native woman from Siam. Since then immature worms have been recovered from peripheral abscesses, cutaneous nodules or while migrating under the skin, in Malaya, Japan, China, India, and North Queensland. The only reference of a human being harbouring the adult worm in the intestinal tract is that of Chandler (1927), who on two occasions found eggs of *Gnathostoma spinigerum* in examination of stools presumably human from Burma and Eastern Bengal where the infection is very common in cats. Siam is the country of greatest prevalence of this worm both in human and reservoir hosts.

Structure of adult worm.—The length of the adult male worm in tigers is 11.25 mm., and female worm 25.54 mm. In dogs they are somewhat smaller and in cats they are still restricted in size. It is reddish in colour, slightly transparent with a globular

cephalic swelling separated from the rest of the body by a cervical constriction. The oral end is frequently curved ventrad, whilst the posterior end is strongly curved ventrad and inwards. The anterior half of the worm's cuticle is provided with leaflike spines which are most common immediately behind the cervical region, become less common behind the equatorial region while the posterior part of the body is entirely devoid of spines and the cuticle is entirely smooth. Superficial annular creasings of the body are common. The head portion of the mature worm is covered with eight transverse rows of simple sharply pointed recurved hooks. The mouth opens into the oesophagus. Four club shaped cervical secretory glands are arranged symmetrically round the oesophagus.

Life cycle.—From the eggs first stage larvae are hatched in water. On ingestion by any variety of cyclops, second stage larvae develop. They are like the immature worm but much smaller. In the second intermediate host, which is either a fresh water fish, a frog or a snake, adolescent or immature worms develop. They are encapsulated in muscles, liver, mesentery or other tissues. The immature worm has a head bulb encircled by four rows of spines, a distinct digestive tract and two pairs of cervical secretory glands. The worm reaches its adult form in its reservoir host which is either tiger, cat, dog or man. The reservoir host acquires the infection by eating infected fresh water fishes, frogs or snakes. It is not known whether human infection takes place in this way or by accidental swallowing of infected cyclops in raw drinking water. It is problematical whether the larvae enter the human body via the skin or the mouth, although the latter route is the common one in other reservoir hosts.

Pathogenicity and symptomatology.—Lesions produced in the intestinal wall, primarily in the stomach, have been described from non-human hosts. They consist of indurated nodules around one or more mature or maturing worms, which lie free in an abscess pocket in the centre of the nodule. The worms are bathed in a milky purulent exudate. There is frequently an opening into the intestinal lumen through which the eggs laid by the adult females are discharged. The peripheral lesions, seen in the human hosts, are dermal or subdermal in position and consist of nodules with abscess centres or tunnels between the epidermis and corium with infiltration of a large number of eosinophils and plasma cells. The migrating variety causes creeping eruptions. The development of immature worms in peripheral abscess pockets or their migration in tunnelled passages under the superficial layers of the skin produces extreme discomfort consisting of intermittent pricking pain and continued dull pain. Marked eosinophilia is present.

Case report

M.N.S., Hindu brahmin male, aged 26 years, of Serajgunj, Northern Bengal, was admitted into the Eye Infirmary for the investigation and treatment of orbital cellulitis with haemorrhages in the retina and the vitreous in his left eye.

Habits and previous history.—He is a man of average build and looks slightly anaemic. He had very rarely visited Eastern Bengal and that was only for a day or two. His habits are regular. He lives on average bengali diet consisting of rice, pulses, vegetables and fish, milk irregularly and eggs and meat rarely. He had never eaten raw or dried fish. He does not drink or smoke. He does not remember having suffered from any serious illness, any attack of urticaria, any painful transient swelling or any creeping eruption in any part of the body.

History of present illness.—On May 25, 1944, he felt a dull aching pain on the left side of his nose extending to the frontal and temporal regions on the same side. On May 26, 1944, the pain increased and a swelling appeared on the left cheek extending to the lower eyelid. The swelling was very itchy. On May 29, 1944, the swelling had increased and spread from the angle of the mouth to the roots of the hair on the same (left) side. The eyelids were so swollen that he could not open the eye. He was running a low temperature till June 5, 1944, when he reported at the outpatient's department of the Eye Infirmary.

Examination.—On that day, he had no swelling of his left cheek and forehead, but the lids were swollen and oedematous, the conjunctiva was chemosed, movements of the eyeball were restricted, the pupil was slightly dilated and reacted to light sluggishly, the tension was normal, and the vision was 6/6. The right eye was normal. He was given treatment for orbital cellulitis including sulphonamide 4 tablets stat. and 2 tablets every 4 hours. Two days later on June 7, 1944, he reported again, complaining of dimness of vision and increase of pain in the eye. His vision had fallen to hand movements only. The swelling of the lids and the chemosis of the conjunctiva had almost disappeared and the movements of the eyeball were almost normal. The pupil was slightly more dilated and reacted sluggishly to light and the tension was normal. On examination of the fundus, the vitreous was hazy, the retinal veins were engorged and there were haemorrhages from the veins on the upper part of the disc and the upper temporal and nasal parts of the retina. On admission to the hospital on June 8, 1944, the swelling of the lids and the chemosis of the conjunctiva had completely disappeared, movements of the eyeball were normal, the pupil was still dilated and sluggish in reaction to light, tension was normal, and the

haemorrhages in the vitreous and retina had increased. On investigation, the vascular, gastro-intestinal, respiratory and nervous systems were normal. No septic foci were found in the gums, throat, nose and nasal sinuses. No albumin, sugar, or casts were found in the urine. The total R.B.C. was 3,800,000, haemoglobin was 60 per cent. The total W.B.C. was 7,200, of which polymorphonuclears were 66 per cent., lymphocytes 26 per cent., large mononuclears 4 per cent. and eosinophils 4 per cent., blood coagulation time was $3\frac{1}{2}$ minutes and the bleeding time was 2 minutes. W.R. was negative. Blood taken at midnight for microfilaria was negative. B.P. was 110 systolic and 80 diastolic. In the stools a few hookworm ova were found. The anaemia and slight eosinophilia were considered to be due to hookworm infection. On June 11, 1944, three days after his admission to the hospital he developed severe iritis in the eye. The corneal epithelium was slightly oedematous, anterior chamber was hazy, there were several grey nodules on the iris of the size of a pin's head between "11 and 2 o'clock" regions and a large irregular grey exudate between the iris and lens capsule at "1 o'clock," the tension was slightly raised and the vision was light perception only. The iritis responded to the usual treatment and on June 13, 1944, the corneal epithelium and anterior chamber were clear, pain and ciliary injection were much less, but the pupil was only half dilated. The eye was completely quiet by June 19, 1944, the grey nodules had all disappeared leaving grey depressions on the iris and at "1 o'clock" there was a posterior synechia and the pupil was two-thirds dilated, the vitreous haze had increased, and the vision was perception of light. At this stage the condition was considered to be one of septic (metastatic) iritis. On June 20, 1944, the eye was again irritable and a large grey nodule projecting into the anterior chamber had appeared at "6 o'clock"; the pupil had slightly contracted in spite of atropine ointment being continued, and pigmented keratic precipitates were noticed for the first time; the tension was slightly raised. On June 29, 1944, the eye was still irritable, the grey nodule at "6 o'clock" had disappeared leaving a grey depression on the iris, and a pigmented nodule had appeared at "5 o'clock." On July 7, 1944, the eye, which was settling down, was again irritable. The pigmented nodule at "5 o'clock" had disappeared leaving no mark and a new pigmented nodule of larger size had appeared at "6 o'clock." On July 12, 1944, this pigmented nodule had become larger, about 4 mm. in size, and the eye was very irritable, and the tension was raised. In the evening the nodule was found to be moving and on closer examination it was found to be a worm. On July 13, 1944, the pain was the worst the patient had ever experienced. The eye was much worse and the tension was

raised. On examination with the slit-lamp under a magnification of 23, the corneal epithelium was oedematous and the worm could be seen through the hazy cornea. It showed a blunt end (head) and a conical end (tail) with two spots of iris pigment attached to the tail. The head and tail showed slow wavy movements. The central part was never seen being behind the limbus evidently embedded in the iris tissue. It was translucent in appearance and a central dark streak (alimentary canal) could be seen. The appearance of the worm was not that of a filaria Bancrofti, and it was too translucent to be a maggot. So it seemed to be an unknown soft worm. On July 14, 1944, the condition of the eye was bad but the pain was a little less. The movement of the worm had stopped and the size of the nodule was smaller. The worm was either dead or it had burrowed deeper. If it burrowed deeper into the ciliary body, the pain would have been much worse, so it was presumed that the worm was dead. An operation for the removal of the worm could not be undertaken on July 13 and 14. On a culture of a conjunctival swab, a few colonies of *staph. albus* were found.

The operation on July 15, 1944.—It was realised that unless the whole worm was removed the eye would have to be removed ultimately. As the worm was fixed in the middle it would not gush out with the aqueous. As the worm was a soft one, the chance of removing the whole worm with iris or any other forceps after a limbal incision away from the worm was remote. A limbal incision at "6 o'clock" was out of the question as it might cut through the worm. So a large incision was planned provided the tension of the eye could be brought down. It was decided to try to bring down the tension by blocking the ciliary ganglion and waiting for half an hour or more, and failing this to do a posterior sclerotomy. One c.c. of novocaine (2 per cent.) with two drops of adrenaline (1 in 1,000) was injected into the region of the ciliary ganglion. Fifteen minutes later, the facial nerve was blocked by O'Brien's method, and cocaine (4 per cent.) was dropped into the conjunctival sac 3 times at 5 minutes interval. Half an hour after the ciliary block the tension was found to be lower than that of the right eye. Then after all the preparations for an intra-ocular operation, a thin Graefe knife was introduced into the anterior chamber at the limbus at "3 o'clock"; the counterpuncture was in the cornea at "7 o'clock" about 3 mm. from the limbus. The cornea was cut through just above the worm from the region of the counterpuncture to the limbus at "4.30 o'clock." The limbal incision was completed with a conjunctival flap. The cornea was lifted up by holding the conjunctival flap with a small dissecting forceps and a lens curette was introduced between the cornea and the iris at "6.30 o'clock" up to the angle of the anterior chamber.

The worm was gently removed and put into a specimen tube containing 70 per cent. alcohol. There was no complication during the operation.

It was found to be a curved worm about 4 mm. long completely covered with iris pigment. Dr. A. K. Mukerji and Dr. N. V. Bhaduri of the Helminthological department of the Tropical School of Medicine, Calcutta, identified the worm as an immature *Gnathostoma*, and gave the assurance that the whole worm had been removed.

After the removal of the worm the patient made an uneventful recovery. On July 18, 1944, the eye was quiet; the cornea was clear, the pupil was widely dilated and there was neither posterior

nor anterior synechia. The fundus detail could not be seen. On July 26, 1944, some fundus detail could be seen with difficulty a few spots of haemorrhage were seen in the retina, and the disc appeared grey. He was discharged from the hospital on August 7, 1944, and was advised to report every fortnight. On discharge more fundus details could be seen, the haemorrhages had disappeared from the retina and the vision was finger counting at $\frac{1}{2}$ metre. On August 23, 1944, the vitreous was still slightly hazy, the disc was grey and the arteries were thin. The most interesting observation, however, was an ill defined circular grey area below the macula, as this might have been the spot through which the worm burrowed into the eyeball. The vision had improved to finger counting at 1 metre. On October 17, 1944, the cornea was clear, the incision mark through the cornea was just a thin line and the vitreous was quite clear. The disc was atrophic and the arteries were thin and sheathed. The ill defined grey area below

The worm after removal.

Slit-lamp view of the worm.

the macula was now a well defined scar area roughly circular in outline and surrounded by pigment and the diameter of the scar was about one-third that of the disc. As no other similar area was present in the fundus and this scar area was not present on the first day of the examination on June 7, 1944, it is thought that probably this was the area through which the worm entered the eyeball. Furthermore the diameter of the worm and the diameter of the scar are comparable in size. The vision had improved to finger counting at 2 metres.

The size of the worm, as measured by Dr. A. K. Mukerji, is as follows—length 3.5 mm., maximum width 0.41 mm., level of maximum width 1.8 mm. from the anterior end, width of the head 0.25 mm., and the number of rows of spines on head bulb 4.

Summary

Onset with a dull aching pain on the left side of the nose extending to left frontal and temporal regions, then swelling of the face extending from the angle of the mouth to the roots of the hair were followed by orbital cellulitis and vitreous and retinal haemorrhages. In the hospital, he had two attacks of iritis with the development of grey nodules on the iris which completely disappeared leaving grey depressions on the iris. This was followed by two more attacks of iritis with the development of a single pigmented nodule on the iris in each attack. The pigmented nodule completely disappeared leaving no mark after the first attack. In the second attack, which was the most severe, the pigmented nodule was seen to be the worm. The worm was removed at operation and the eye made an uneventful recovery though optic atrophy developed.

Comments

Without the discovery of the worm the case would have been most puzzling, as the condition could not be fitted into any known clinical condition. The habit of the *Gnathostoma* of burrowing through the tissues and migrating from place to place explained all the signs specially the inflammation which, before subsiding in one place, appeared in a contiguous place in quick succession.

If the infection took place through the gastro-intestinal tract, it must have been through swallowing infected cyclops in raw drinking water. It was not very clear how the worm came to the side of the nose from the stomach without causing any sign or symptom. However, the probable area of its entry into the eyeball from the orbit could be seen as a scar just below the macula. Marked eosinophilia is said to be a sign of this infection, but in this case eosinophilia was only 4 per cent.

Conclusion

A case of *Gnathostoma* in the anterior chamber of the eye is described. This is probably the first recorded case of this worm in a human eye. An incision has been planned to remove the worm which can be used for removing either a cyst or a non-magnetic foreign body from the angle of the anterior chamber.

Thanks are due to Dr. A. K. Mukerji and Dr. N. V. Bhaduri for identifying the worm, and providing the photomicrograph and the measurements of the worm, and also to Capt. E. J. Somerset, I.M.S., for many helpful suggestions in preparing the paper.

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A CASE OF OCCIPITAL LOBE INJURY*

BY

J. MACASKILL, Maj. R.A.M.C.

LESIONS of the occipital lobe and the ocular changes accompanying them are well known. There may be interest, however, in the record of an occipital lobe injury in which the extent and nature of the damage were demonstrated at operation.

Cpl. G. M., aged 22 years:—This soldier received a gun shot wound of the thigh at Kohima, in April, 1944. Five days later, when in the Field Ambulance, a shell burst near him and he was hit on the right side of the back of the head, and two days later received further small body wounds.

Consciousness was never lost, but after the head injury he could not see at all to the left side. One week later objects far out on this side could be seen, but he was aware of a non-seeing area towards the centre of vision. He could read newsprint but complained that while seeing one word the one adjacent to it disappeared, and on looking at his hand only saw the fingers on the right side.

When examined three months after the injury, there was a healed depressed wound in the occipital region to the right side of the mid line. Both eyes were normal and had full vision, though the letters on the chart were read scotomatically. The peripheral areas of the visual fields were unimpaired but para-central defects existed which are seen in the reproduction of the central field charts.

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