Of the children who were vomiting food more than once daily 57.7% stopped vomiting within a few days after the treatment, and in another 20% vomiting was relieved.

Decompression treatment is usually unsuccessful at a stage of the disease earlier than two and a half weeks and is harmful to the acutely ill case with pyrexia, cyanosis, or appreciable atelectasis.

The results reported are based on careful selection of cases and combined assessment by parents and doctors. An adequate controlled experiment has not yet been done but should be attempted when opportunity offers.

The mechanism of the action of decompression in whooping-cough has not been elucidated. Further trials should preferably include biochemical studies.

I thank my colleague Dr. L. J. M. Laurent for his valuable co-operation throughout, for reporting on a visit to Dr. Richou and others in Paris in 1948, for his part in the conduct of the clinic, and particularly in the assessment of the results.

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CEREBRAL CYSTICERCOSIS

COMMON BUT UNFAMILIAR MANIFESTATIONS

BY

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Though cerebral infestation with the larval stage of the *Taenia solium* has been recognized since the middle of the last century, it was after the extensive work of MacArthur (1934), Dixon and Smithers (1934), Brailsford (1941), and Dixon and Hargreaves (1944) that cysticercosis was given an important place among the conditions causing epilepsy. So well known is this that the diagnosis is unlikely to escape consideration in a patient suffering convulsions who has lived or served in India or the Far East.

It is the purpose of this paper to emphasize the clinical manifestations of this disease, other than epileptic convulsions, which, though both important and common, have received scant attention in this country. At the same time it will be seen that India and the Far East are not the only, nor even the main, areas where the condition may easily be acquired. Brief illustrative case histories are given, grouped under appropriate sub-headings, but, as will be evident, the same patient may show several different features.

Periods of Disordered Behaviour

This group includes a wide variety of abnormal manifestations, unassociated with any true convulsion, but occurring during periods of disturbed consciousness, accompanied sometimes by involuntary micturition, and often consisting of bizarre or violent behaviour.

Case 1.—A Polish male aged 41 was examined on May 28, 1954. Since 1945 he had been subject to frequent attacks of

violent behaviour, lasting three to five minutes, accompanied occasionally by involuntary micturition, stopping suddenly, and followed by several hours' deep sleep. The day before examination he had, without warning or provocation, attacked a friend with a chair, resisted the restraint of five men, and then suddenly passed into a deep sleep, having no memory of the incident on waking. Physical examination was negative, but a white blood count showed an eosinophilia of 800 to 950 per c.mm. Skull x-ray films were normal, but x-ray films of the thigh muscles showed typical calcified cysticerci. The attacks were greatly improved by the use of primidone.

Case 2.—This patient, a Polish boy aged 11, was born in Austria and had lived five years in the Ukraine. Since early 1954 he had been subject to attacks, usually during breakfast, in which he would make grimacing movements of the face for one minute, then sit quite still staring into space for two or three minutes, then repeat several numbers, and suddenly return to normal, though sometimes a little drowsy afterwards and with slight headache. Physical examination on September 17, 1954, was negative, but a white blood count showed a constant eosinophilia of about 1,000 per c.mm. Stools were normal. X-ray films of the thighs showed calcified cysticerci.

These probably represent attacks of psychomotor epilepsy, and it is remarkable how infrequently the standard leads of the electroencephalogram are of help in cysticercosis. It is possible that the lesions are situated in areas of the temporal lobes which would require more elaborate techniques to demonstrate.

Transient Loss of Function

The sudden loss of use of, or of sensation in, a limb, or the sudden loss of speech, with subsequent rapid recovery, is not uncommon in the early stages of a cerebral neoplasm and in cerebrovascular disease. Episodes of this type are often seen in cerebral cysticercosis, and have on occasion, in apparently healthy young soldiers, been regarded as hysterical.

Case 3.—A British man aged 20 was admitted to the Queen Elizabeth Hospital, Birmingham, on November 10, 1953, complaining of three episodes, in the previous five years, of sudden loss of use of the left hand, with numbness of the hand, rapidly recovering. One attack lasted several hours. He had in addition, and at separate times, had several episodes of unexplained loss of consciousness. He lived the first ten years of his life in India. Physical examination was negative and a full blood count normal. The cerebrospinal fluid contained two mononuclear and one polymorphonuclear cells per c.mm., with 132 mg. of protein per 100 ml., and a paretic Lange curve. The electroencephalogram showed only very occasional 5-6 c/sec. waves occurring synchronously in all leads. X-ray examination of the skull showed a number of small foci of intracerebral calcification, and x-ray films of the thigh muscles showed numerous calcified cysticerci.

Case 4.—A British ex-Regular-Army soldier aged 32 who had spent two periods of service in India and China was admitted to the Queen Elizabeth Hospital, Birmingham, on October 23, 1941, complaining of periods of sudden onset of loss of speech during the previous six years, usually lasting several hours, but on one occasion lasting three days. The most recent attack was accompanied by paralysis of the right arm and leg for several hours, recovery being very rapid. In addition, and at separate times, he had had periods of unexplained loss of consciousness, during one of which he had passed urine, and during another had fought off those who had come to his assistance. Physical examination was negative apart from two small subcutaneous nodules in the left arm and the left thigh. A full blood count and x-ray examination of the skull were normal, but x-ray films of the thigh muscles showed numerous calcified cysticerci. Biopsy showed the subcutaneous nodule from the arm to be a lipoma, but that from the thigh proved to be a cysticercus.

Acute Intermittent Obstructive Hydrocephalus

This, though one of the longest-known non-epileptic manifestations of intracranial cysticercosis, is one of the least well recognized in England. Bruns's symptom-complex (Bruns, 1906) consisted of the sudden onset of violent headache, vomiting, tinnitus, and vertigo, passing on in the more severe attacks to deep coma and even death, and often precipitated by sudden movements of the head. It was considered to be diagnostic of a solitary cysticercus in the fourth ventricle.

Case 5.*—A Polish woman aged 54 was admitted to the Midland Centre for Neurosurgery on October 1, 1954, having suffered for two years from episodes of sudden onset of severe headache, vomiting, and ataxia, passing on to a stupor lasting 24–48 hours, and recovering spontaneously. She was normal between attacks, but a C.S.F. pleocytosis had been demonstrated elsewhere. Shortly after admission she became rapidly comatose and despite surgical decompression died in a few hours, with signs suggestive of a medullary pressure cone. Necropsy confirmed this, and revealed a solitary cysticercus impacted in the fourth ventricle and numerous cysticerci in the substance of the hemispheres.

The solitary intraventricular cysticercus is, however, not the only cause of acute obstructive hydrocephalus. Some years ago my colleagues and I drew attention in this country to the racemose form of cysticercosis which is particularly apt to form at the base of the brain, and, being a mobile structure, sometimes with a long pedicle, is capable of intermittent blocking of the roof foramina of the fourth ventricle (Bickerstaff *et al.*, 1952).

Case 6.—We described the case of the wife, aged 50, of an ex-Indian Army soldier who for ten years had suffered attacks of headache, each of which increased in severity over several hours, accompanied by vomiting, and culminating in drowsiness and finally coma, but recovering spontaneously within 24 hours. She had had an intermittent blood eosinophilia over many years. Exploration of the posterior fossa revealed a delicate irregular elongated cystic structure, resembling a bunch of grapes, lying over and around the lower brain stem and fourth ventricle and hanging into the upper cervical region. The patient died some weeks after the operation, and necropsy revealed numerous encysted cysticerci in the hemispheres and basal ganglia. Histological examination of the wall of the racemose structure showed it to consist of three distinct cellular layers identical with the lining of the walls of the intracerebral cysts.

Since then I have investigated in the Midland Centre for Neurosurgery two further cases of this type, both Polish and both having attacks of intermittent hydrocephalus. One showed Bruns's symptom-complex, and had a solitary cysticercus in the aqueduct and a racemose structure in the left cerebello-pontine angle; the other had a racemose cysticercus extending from the third ventricle, through the aqueduct and into the fourth ventricle. This contained one large degenerating larva. These cases will be published in full clinical and pathological detail later.

Disturbance of Equilibrium

Though spasmodic ataxia may accompany the attacks of obstructive hydrocephalus, a more progressive disturbance of equilibrium, without marked ataxia of the limbs when supine, frequently accompanies the posterior fossa racemose cysticercosis, the clinical picture simulating that of a tumour of the vermis of the cerebellum.

In Case 6 the patient had in the last four years of her life become increasingly, and finally completely, incapacitated by a gross ataxia of gait, but only in the last few weeks had she demonstrable ataxia on the usual bedside tests.

Of the important series of 13 cases of racemose cysticercosis described by Arana and Asenjo (1945), 7 presented first in this manner.

Meningo-encephalitis

Attacks of meningo-encephalitis, usually self-limiting, the cerebrospinal fluid containing both lymphocytes and polymorphonuclear cells, occur not infrequently throughout the course of the disease (Schmite and Lemoyne, 1932; Dolgopol and Neustaedter, 1935; Felici, 1938; Obrador, 1948).

Our Case 6 had three episodes of headache, with meningism, vomiting, confusion, and drowsiness, lasting several days and clearing up through a period of noisy and aggressive behaviour. Her cerebrospinal fluid was grossly abnormal on each occasion—for example, 270 cells (90% mononuclear), with a protein of 150 mg. per 100 ml. and a Lange curve of 5433221000.

*This case will be published in full clinical and pathological detail elsewhere.

It is during episodes of this nature that the diagnosis, if suspected, will receive great support from the demonstration by special stains of eosinophils in the cerebrospinal fluid.

One further patient, following surgical intervention with a racemose cysticercus, developed the clinical signs of an intense meningo-encephalitis, the cerebrospinal fluid containing over 1,000 eosinophils per c.mm.

Failing Vision

Cysticerci may lodge in the eye, the orbit, or at the chiasma. Such direct local effects are, however, not always the cause of visual failure, for it may be due to the consecutive optic atrophy which follows long-standing and perhaps unsuspected papilloedema, the site of the lesion being either in the ventricular system or in the posterior fossa.

Case 7.—A 35-year-old ex-Indian Army soldier complained in 1945 of failing vision over the previous two years. He had a past history of fits, and examination revealed a chronic papilloedema which had progressed to a consecutive atrophy. His cerebrospinal fluid contained 33 mononuclear cells, 92 mg. of protein per 100 ml., and a paretic Lange curve. X-ray films of the muscles showed numerous calcified cysticerci, and an air encephalogram showed dilatation of the third ventricle, and forward displacement of the fourth ventricle. It is probable that there was a racemose cysticercus in the posterior fossa, but proof was not obtained.

Case 6 also had severe consecutive atrophy of the optic disks, with gross loss of vision, following long-standing raised intracranial pressure. Necropsy confirmed that there were no cysts in relation to the eyes or chiasma.

Involuntary Movements

Very rarely, cysts in the basal nuclei, or secondary degenerative changes in this region, may be associated with involuntary movements. Meyer (1906) described tremor of the right side; Felici (1938) described Parkinsonism, and Broughton-Alcock *et al.* (1928) and others refer to involuntary movements.

Our Case 6, for the last four years of her life, showed at first a constant restlessness which, as it increased, developed into frank bilateral choreic movements of considerable amplitude, affecting all four limbs and the face, and with the associated mental impairment the clinical picture resembled Huntington's chorea. At necropsy a large cysticercus was found in the left caudate nucleus, and seven smaller cysts in both the caudate and the lentiform nuclei.

Mental Disturbances

Personal experience of this aspect has been limited to the development of mental deterioration in patients predominantly displaying other manifestations of the disease. Stepien and Chorobski (1949) and Pinto Pupo *et al.* (1945–6) stress mental disturbance as a presenting symptom, as did MacArthur (1934).

In the present series, Case 1 was showing increasing aggressiveness, irritability, and unreliability of behaviour quite apart from his psychomotor attacks, and Case 6 for several years had had memory impairment, irritability, and mood swings, and her hospital investigations were hampered by a series of self-discharges.

One further Polish patient has recently been seen, presenting a purely psychotic state, but having scattered flecks of intracranial calcification, and a high blood eosinophilia. Cysticercosis was suspected, but so far has not been proved.

Discussion

The incidence of human cysticercosis is of course related to the amount and mode of pork consumption in a given area rather than to any local variant of the *Taenia solium*. Inhabitants of a country in which pork is often consumed in a raw or partially cooked state are constantly exposed to the danger of contracting a tapeworm, and any carrier of

an intestinal tapeworm is a potential danger to himself and others. Any fault in personal cleanliness may cause contamination of food with ova, and subsequent development of cysticercosis in the consumer's muscles or brain. It must be remembered that it is not eating measly pork which results in human cysticercosis, but the ingestion of tapeworm ova as a result of contamination of food by human faeces—a danger over which any given individual has much less control.

The number of cases found in Army personnel returning from India has fostered the view in this country that India is the most likely area where infestation may occur. Cases have, however, been reported from a great number of countries, and a good review of the geographical incidence is given by Trelles and Lazarte (1941). The ease which now attends world travel, and the great movements of populations during the war and the post-war period, have resulted, and will continue to result, in the natives of many countries making their homes in Great Britain. There are thought to be about 600,000 natives of Poland, the Ukraine, and neighbouring countries living in this country at the present time and coming under our medical care. When one considers that in Warsaw, at the Neurological Institute, between 1926 and 1936, cerebral cysticercosis formed 1.25% of all admissions—1 in 80 patients (Stepien and Chorobski, 1949)—it would be surprising if among such a community one did not encounter many examples.

Southern Italy and Portugal provide a number of cases, and it was at one time very much more common in Germany than it is now. Surprisingly few have come from the north of Africa and Egypt, but Dixon and Smithers (1934) recorded several from South Africa. It is very uncommon in the United States, but in South America, on the other hand, some of the most extensive work on the subject has been carried out—notably the detailed review and description of 26 new cases from Brazil by Pinto Pupo *et al.* (1945-6) and the monograph by Trelles and Lazarte (1941) of Peru. It is common in Colombia; and in Chile cerebral cysticercosis formed 12½% of all suspected cases of cerebral tumour during a two-and-a-half year period (Arana and Asenjo, 1945).

The pathology of the intracerebral encysted cysticercus is well known, but in this country insufficient attention has been paid to the effects of the infestation of the cerebrovascular system. Post-mortem examinations have shown a constant periarteritis and endarteritis in both the meningeal and the smaller cerebral vessels, particularly in the vicinity of the cysts. These vascular changes may be most important in the production of transient or permanent ischaemic lesions in the brain. The sudden attacks of loss of function of a limb or of speech lasting several hours and then recovering seem more likely to be due to transient ischaemia than to be epileptic manifestations. Again, the cerebral atrophy which may develop is probably secondary to long-standing vascular insufficiency, and the mental changes and some of the degenerative basal ganglia lesions may well be of similar origin. The late clinical picture in some patients is that of a crippling hemiplegia, and it is more probable that this is due to occlusion of a major vessel than to the mere presence of cortical or subcortical cysts.

It is in South America that the major work of recent years has been carried out in connexion with cysticercosis of the posterior fossa—the solitary intraventricular cyst, the racemose variety, and the basal meningo-encephalitis. A given patient may have one of these types, or any combination of the three, and each is capable of giving a clinical picture resembling a posterior fossa tumour with increased intracranial pressure—the first by blocking cerebrospinal fluid flow through the ventricular system, the second and third by obstructing the roof foramina of the fourth ventricle.

It is important to recognize the solitary intraventricular cyst, because its successful removal will relieve the patient of his symptoms referable to C.S.F. obstruction. This has

often been done—for example, Arana and Asenjo (1945)—and, even if removal is impossible, Torkildsen's procedure may give considerable relief.

Basal meningo-encephalitis is a more serious condition, as the consequence of recurrent attacks is a chronic arachnoiditis around the base of the brain, which can cause permanent interference with C.S.F. circulation and also with blood flow within the basilar system. Relief of this surgically is rarely possible, and, though short-circuiting operations may give temporary relief, the prognosis is bad. It is interesting that during this stage eosinophils may be found in the C.S.F. if special stains are used, and it is possible that it represents an allergic response to some allergen liberated from the parasite rather than a direct result of irritation. Some support was gained for this view by a recent experience of treating such a case with anti-histamines, with rapid improvement in pyrexia, the general condition of the patient, and the C.S.F. reaction.

The so-called racemose cysticercus is an elongated sac-like structure, varying greatly in size, having a central cavity from which grow many cystic projections, each having a delicate translucent wall, and the whole, though occasionally lying free in the ventricles, usually being lightly attached to the basal meninges by a long pedicle. The structure so formed resembles a bunch of grapes, and by virtue of its mobility is capable of causing intermittent C.S.F. obstruction and interference with vascular supply to the brain stem and cerebellum. The wall is histologically the same as the lining membrane of the intracerebral cysts, but the structure usually contains no hooklets or scolices.

We suggested previously (Bickerstaff *et al.*, 1952) that this structure was a reaction of the meninges to the presence of a parasite, and that its particular type of development was due to the constant flow of C.S.F. and the space allowed by the cisterns for expansion; we also thought that this received support from the fact that the other site of development was in the cavity of the lateral ventricles. As stated earlier, however, a larva was discovered in one of these racemose structures, and I now feel that they represent an actual cysticercus about which there has failed to form the host tissue reaction which completes the encirclement of the better-known intracerebral cysts, thus limiting their growth.

A similar racemose structure is formed by the larval stage of the dog tapeworm *Multiceps multiceps*, but in this case it is a coenurus and not a cysticercus which is formed—that is, a cyst containing numerous invaginated scolices, as opposed to the single scolex of a cysticercus. When a racemose body is formed in cerebral coenuriasis, several hundred scolices may be discovered (Johnstone and Jones, 1950; Becker and Jacobson, 1951). This difference in the number of scolices in the two parasites is important, for while several score of scolices may die in a coenurus and still many remain, the death of the single scolex in a cysticercus will result in a sterile cyst. Trelles *et al.* (1952) believe that death of the parasite disturbs a balance existing between it and the cyst wall, and disorderly proliferation follows, forming this remarkable racemose structure.

The diagnosis of these posterior fossa forms of cysticercosis is of more than just academic interest, for here there is offered a practical chance of alleviating symptoms by surgical means, which in the other forms of cerebral cysticercosis have been disappointing. Diagnosis will be made only if the possibility is always at the back of one's mind when faced by intermittent obstructive hydrocephalus, and in the differential diagnosis of posterior fossa lesions—for the confirmatory signs of cysticercosis (calcification in muscles or brain and eosinophilia in blood or C.S.F.) may all be absent. The possibility must assume greater prominence when the patient comes from, or has been in, one of the areas where the condition is frequently acquired, and attempts should then be made to obtain confirmatory evidence.

It should be remembered (a) that calcification in the brain is much less common than in the muscles of thighs

or pelvis; (b) that blood eosinophilia is often intermittent, and may be absent on any particular examination; and (c) that a pleocytosis in the cerebrospinal fluid may not only show eosinophils, if a suitable stain is used, but is often associated with a paretic Lange curve.

Finally recourse must be made to ventriculography, using air or opaque contrast media, which may not only define the site of the obstruction but also outline the shape and size of the cysts responsible, and give valuable information about the possibility of surgical removal.

Summary

Attention is drawn to clinical manifestations other than epileptic convulsions which frequently occur in cerebral cysticercosis, and to the countries other than India where infestation is often acquired.

Cases are described illustrating periods of disordered behaviour, transient pareses, intermittent obstructive hydrocephalus, dysequilibrium, meningo-encephalitis, involuntary movements, failing vision, and mental disturbances.

Stress is laid on the cerebrovascular lesions, and on the importance of the posterior fossa forms of the disease.

I wish to thank the medical staff of the Polish General Hospital, Penley, for referring to me Cases 1, 2, and 5; to Professor P. C. Cloake for permitting me to investigate Case 3; to Professor W. H. Wynn for allowing me to include Case 4; and to Sir Russell Brain for permission to use brief extracts from *Brain* (Case 6).

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"The whole emphasis to-day is on drawing as little difference as possible between the handicapped child and the normal child," said Mr. DENNIS VOSPER, Parliamentary Secretary to the Ministry of Education, at a conference of the College of Teachers of the Blind at Matlock on April 22. Between 1945 and the end of 1954, he said, 256 new special schools, with 18,000 new places, had been established, but there were still considerable waiting-lists, and careful selection was essential. Only when ordinary day-school education had proved impossible was special training considered. Teaching handicapped children was onerous, and it reflected credit on the profession that there had been sufficient teachers coming forward to fill the posts in the new schools. A few handicapped children would never become self-supporting, continued Mr. Vosper, "but education will help to make them all better members of the family circle, and to make the majority more likely to take their place as worthy and self-supporting citizens in the world."

SPONTANEOUS HAEMOPNEUMOTHORAX

A SURGICAL EMERGENCY

BY

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Spontaneous haemopneumothorax is a comparatively rare condition. A review by Borrie (1953) showed the recorded total to be 93 cases with 19 deaths. Subsequently McGown (1954) has reported another case. The source of bleeding and air escape is usually a ruptured bulla with or without a torn adhesion. Sometimes a torn adhesion alone is found; sometimes there is no demonstrable lesion, which means that the breach in the lung surface, from which so much blood and air escapes, is either so small as to be missed or has already healed so far as naked-eye examination can detect. Although the precipitating factor is apparently traumatic, a history of trauma, beyond ordinary everyday activity, is usually absent, the causal episode being so mild in type as to be overlooked. The important features, for both prognosis and management, are not so much the cause and source of the bleeding as its extent, the tendency to clot earlier than in ordinary traumatic haemothorax, and the fate and subsequent effects of this clot if it remains in the pleural cavity.

The traditional method of management in medical wards, on the principle of minimum interference, has carried in the past a high mortality. In 18 fatal cases death followed conservative treatment. In the remaining case (Hansen, 1949) the patient died after delayed thoracotomy. Conservative treatment, the difficulties of which are well put in Hartzell's (1942) paper, has been challenged by several writers. Myers *et al.* (1951) recommended emergency thoracotomy if bleeding could not be controlled, and reported a successful case. Ross (1952) regards the condition as a surgical emergency, requiring urgent blood replacement and early evacuation of the intrapleural blood before it clots. This he did by underwater intercostal drainage, recommending thoracotomy if there were evidence that bleeding was continuing. He reported six cases, one of which required emergency thoracotomy, the remainder being treated by aspiration or drainage, but of these only two gained full re-expansion this way, the remainder requiring decortication. Borrie (1953) recommends immediate thoracotomy, after resuscitation, as the treatment of choice for all cases of spontaneous haemopneumothorax in which bleeding has been considerable, and he regards the condition as an acute thoracic emergency. He reports three cases—two treated by emergency thoracotomy for uncontrolled bleeding with complete success and early full expansion, and the third requiring decortication after failure to obtain re-expansion by repeated aspiration.

The object of treatment is to resuscitate the patient and replace blood loss, to arrest the bleeding and to prevent its recurrence, to remove all air, blood, and clot from the pleural cavity, and to obtain and maintain full lung expansion, so that there is a return to full normal function in a minimum of time.