

# The role of Physiotherapy in the management of Tuberculous Meningitis in children

C. A. LIGGINS, M.C.S.P., H.T., Dip.T.P.

(Senior Lecturer in Physiotherapy, Joint Medical Establishment, Natal Provincial Administration/University of Durban-Westville)

*This paper was presented at the Regional Congress of the Commonwealth Medical Association (Lesotho 1975).*

Tuberculous meningitis is tuberculous infection of the meninges localised mainly to the base of the brain.

It is the worst complication of tuberculosis and a common cause of death from the tubercle bacillus in children.<sup>(1)</sup> If it is not treated it is always fatal or if treatment starts late in the disease and the patient does not survive, there may be mental retardation and/or paralysis of some degree.

Tuberculous meningitis affects children much more than adults and the younger child is usually more seriously affected than the older one; the greatest mortality appears in the age group four years and below.

Statistics in respect of the incidence and mortality rates of tuberculous meningitis have proved difficult to obtain for most countries in the African continent and other developing countries.

Perusal of World Health Organisation figures between 1970 and 1972 show that the mortality rate per 100 000 population varied between 11.3 in Argentina during 1970, and 0 in Israel during 1972. These figures are for children of 14 years and below.

Figures obtained from the 1974 Annual Report of the State Health Department of the Republic of South Africa show that 409 cases of tuberculous meningitis were notified in a total number of T.B. cases of all forms of 57 820.<sup>(2)</sup> This figure, though relatively small, does, however, indicate that tuberculous meningitis is a common complication of T.B. and in 1974 it stood joint seventh in the league of 31 notifiable diseases.

It has been stated that with modern treatment there is 100% recovery without sequelae if treatment for tuberculous meningitis is begun before the child becomes unconscious.<sup>(3)</sup> The most important factor which determines the ultimate prognosis is the time which elapses between the onset of the symptoms and the beginning of the specific treatment.

In the Durban unit, at King George V Hospital, it is considered that if cases are admitted and start treatment within 10 days of onset of symptoms, there should be complete recovery. However, on the average, the cases are admitted at the 2-3 weeks stage, and this has resulted in a recovery rate of 73% of which 50% are mentally or physically handicapped or both.

In 1974, 77 cases were admitted to this unit and judging by these admissions the incidence of tuberculous meningitis does not seem to be declining; in fact it does tend to serve as an index to the incidence of T.B. as a whole.

## **PATHOLOGY**

With tuberculous meningitis, primary tuberculosis is always present initially in some other part of the body.

There are two modes of spread to affect the meninges, one in which there is a latent period before the meningitis manifests itself, except in very young children where the spread coincides with the progression of the primary lesion, and a second, resulting from miliary tuberculosis, which has a much quicker onset.

1. When primary tuberculosis develops in the lung, a "primary focus" is formed. From this there is drainage to the local lymph glands. The primary focus and the affected glands are known as the "primary complex". A few tubercle bacilli break away from this primary complex to cause a bacteraemia. Most of these are combated by the body's defences but some eventually lodge in various parts of the body and remain inactive. Then, during periods of stress, malnutrition, other infections or trauma, the tubercle bacilli may become active and grow. Common sites for this to occur are the brain, bones, joints and kidneys. In the brain a "Rich's focus" is formed; if this breaks down it discharges into the sub-arachnoid space to cause tuberculous meningitis.
2. In miliary tuberculosis there is a rupture of the tuberculous process which discharges directly into the blood stream to cause a tuberculous septicaemia. Wherever the tubercle bacilli then settle, trouble will be caused. In such cases, autopsy has shown that tubercle bacilli are found in almost every organ of the body.

Tuberculous meningitis is always a meningo-encephalitis and the greatest involvement is found in the region around the Circle of Willis. The exudate which forms at the base of the brain involves cranial nerves and may cause obstruction of the basal cisterns, which in turn will give rise to hydrocephalus, which is made worse by excess secretion of cerebro-spinal fluid and poor re-absorption.

Vascular changes frequently occur in tuberculous meningitis, the blood vessels becoming occluded as a result of tuberculous endarteritis, and cerebral infarction of greater or lesser degree follows.

## **SIGNS AND SYMPTOMS**

It was stated earlier that the time lapse between the onset of symptoms and the beginning of specific treatment is the most important factor in determining the prognosis. It is therefore most important that all members of the health team, as well as doctors, are able to recognise the signs and symptoms of this condition.

The mother is usually a reliable witness; she knows that there is something wrong with her child. Unfortunately the early manifestations of tuberculous meningitis, i.e. pyrexia and vomiting, are common to several other, less severe, childhood diseases. The mother will seek help from a doctor, but when the child does not respond, she will probably take the child to one or even two more doctors; thus it becomes difficult for an individual judgment of the course of tuberculous meningitis to be made and the opportunity to make an early diagnosis may be lost in this way.

The signs and symptoms of tuberculous meningitis may be conveniently divided into three stages.

**Stage 1** — (this may last up to 7-10 days).

The onset is insidious with general signs and symptoms

such as pyrexia, vomiting which is not related to the intake of food, diarrhoea in some cases, sometimes a full fontanelle and then neck stiffness.

**Stage 2** — (this stage sometimes starts abruptly).

There is a continuation of the general symptoms with the onset of neurological symptoms, e.g. apathy, drowsiness, sudden crying or screaming, weakness of a limb or limbs, tremor, generalised restlessness, a squint of sudden onset, other cranial nerve palsies, neck stiffness and a bulging fontanelle in infants.

**Stage 3.**

The neurological signs and symptoms become more severe with convulsions, inability to swallow, or talk and unconsciousness.

Convulsions can occur in any stage of the disease, and from the point of view of early diagnosis and treatment and therefore prognosis the earlier they occur the better.

Complaints made by children old enough to talk are very varied, the main ones being:

- (i) vomiting—which come on suddenly,
- (ii) abdominal pain,
- (iii) persistent headache,
- (iv) pain in the legs which are often drawn up.

The neurological involvement of the second and third stages may be due to one or combinations of the following factors:

- (a) the tuberculous exudate preventing adequate circulation of the cerebro-spinal fluid in the brain, the resultant rise in intracranial pressure causing the brain substance to be compressed against the skull;
- (b) the inflammatory process which augments the pressure mentioned above;
- (c) the tuberculous endarteritis causing infarction which may give rise to necrosis of brain tissue.

**Diagnosis:** Diagnosis is usually made when the results of the tuberculin test, chest X-ray and examination of the cerebro-spinal fluid become available. However, in view of the serious consequences of delayed treatment it is imperative that the appropriate treatment for the suspected tuberculous meningitis be instituted whilst the necessary investigations are being carried out.

**Treatment:** The successful outcome of the treatment of this disease is dependent on early diagnosis and vigorous treatment.

The guiding principles of treatment are:

1. The use of anti-inflammatory agents in all cases.
2. The use of anti-tuberculous drugs which enter the theca freely.
3. The control of raised intra-cranial pressure.
4. Nursing care and the control of convulsions.

**1. Anti-Inflammatory Agents.**

These should be given as a routine to all patients on admission.

A.C.T.H. gel, Cortizone and Butazolidin may be given singly or in combination, the latter most commonly only in suspected infarction of the brain.

**2. Anti-Tuberculous Drugs.**

There are a number of drugs available. An important point which must be considered when selecting the drug is that it should be one that enters the cerebro-spinal fluid readily and in therapeutic amounts.

Some drugs used in the King George V Hospital are:

- (i) *I.N.A.H. (Neoteben)*. This is effective even when given alone and must always be given even if other drugs are used. It must be introduced by intramuscular injection, as introduction by the oral route is unreliable due to vomiting or mal-absorption. It is usually required for 2-3 months by injection and then continued by mouth.
- (ii) *Ethionamide*. This is well tolerated by children. It is given routinely because of the fear of infection of a child by I.N.A.H. resistant organisms.
- (iii) *Ethambutol* is also used routinely.
- (iv) *Rifampicin* is under trial.

N.B. Streptomycin is seldom required now, but it is only effective if given intrathecally as well as by intramuscular injection, as insufficient enters the theca if given by intramuscular injection only.

**3. Control of Intra-cranial Pressure.**

This may be life-saving in the first few days and may be done by repeated lumbar punctures, or if spinal block is present, by ventricular puncture.

**4. Nursing.**

In the King George V unit the nursing of the patient is regarded as the most important part of the treatment, for it is often only careful nursing that keeps the patient alive long enough for the drugs to be effective.

Nursing should be along the lines of good general care; however, the following points are specific to the nursing of tuberculous meningitis:

- (a) Pressure sores should be prevented by the use of foam rubber under the pressure points, especially the head.
- (b) If the child is unable to swallow, tube feeding will be necessary. The tube should be removed after each feed, as if left in situ for long periods it can cause laryngeal oedema. The disturbance caused by tube feeding may be beneficial in that it makes the patient cough. Intravenous feeding is seldom necessary.
- (c) Care of the mouth is very important. Tube-fed children easily develop stomatitis, as does a child who lies with the mouth open so that the tongue becomes dry.
- (d) Constipation is a much commoner cause of vomiting than any other. If vomiting is cerebral it is controlled by Stemetil suppositories or injection.
- (e) Hourly changes in position help to prevent hypostatic pneumonia and pressure sores. Inhalation pneumonia is prevented by taking care when giving feeds and by quick attention and suction if vomiting occurs. Pneumonia is a very common cause of death in these children.
- (f) Regulation of body temperature is essential. The temperature may rise to 40°C or fall to 33.3°C with great rapidity. The hyper-pyrexia is usually associated with the convulsions and hypothermia with complete immobility of the patient. Both extremes are harmful.
- (g) Oxygen should only be used when the patient would suffer if deprived of it. It should be remembered that oxygen causes vaso-constriction of the cerebral vessels and may cause complete occlusion of a vessel already involved in the basal exudate.
- (h) Great care should be paid to keeping the airway clear. An unconscious patient is liable to suffocate if the airway becomes blocked by secretions, or if the tongue is allowed to fall back.

These patients require close observation and must be nursed with the head extended and turned to one side.

- (i) Convulsions require immediate control as they are very exhausting to the patient. Luminal by mouth or injection or syrup of Chloral and Valium are most commonly used.

### PHYSIOTHERAPY

At King George V Hospital, physiotherapy, occupational therapy and schooling are regarded as essential adjuncts to the medical treatment.

It is not possible to formulate rigid programmes of physiotherapy because tuberculous meningitis produces a wide range of symptoms which differ from child to child. These may range from a conscious and rational child with no neurological signs to a child so deeply comatose or delirious as to be almost inaccessible. In those with neurological signs there may be hemiplegia (which is usually right sided), paraplegia, monoplegia, atetosis and localised or generalised muscle twitching. There may be some spasticity and some flaccidity in the same child. The child may also be blind, but it can recover sight, so it is necessary to watch for any indications of these changes.

Each patient must be carefully assessed in order to obtain and evaluate the clinical picture. Then, since the symptoms are so varied and wide spread, treatment is mainly symptomatic and in broad terms consists of keeping the airway clear, the joints moving and, when the meningitis is resolved, treating the residual disabilities. For practical purposes it is considered that the patients can be treated as having an acquired cerebral palsy and that rehabilitation should essentially be along functional lines.

#### Acute Stage

The child is seriously ill and probably unconscious. It should always be borne in mind that it is very easy to kill him. The position of the head is of utmost importance—a pillow should not be used—the head must be well extended and turned to one side. If the chin is allowed to come on to the chest the child can and will suffocate in a very short time. There will be no struggle, no warning; the child will just be found dead in the cot.

The most worthwhile aims of physiotherapy in this stage are to—

1. Maintain joint range.
2. Keep the chest clear of excessive secretions.

#### Maintenance of Joint Range

A daily assessment of joint range should be made. Gentle passive movements are given every day in as full range as possible, emphasis being placed on areas where it is anticipated that contractures may occur, e.g. the tendo-achilles and the hamstring muscles because of the "frog" position adopted by many patients. Often children are admitted with gross contractures and with careful passive movement these are usually corrected; if not it may become necessary to accept the situation, as when recovery occurs the deformity may correct itself when the child becomes ambulant, or if not it may ultimately require the attention of the orthopaedic surgeon.

There is a danger of myositis ossificans and any acute pain reaction calls for radiographic investigation. If it is found passive movements in the area are discontinued.

Splintage is not usually applied in this stage because of pressure problems which occur as a result of the intermittent spasm causing friction between the part and splint.

#### 2. Chest Physiotherapy

Chest physiotherapy can be life saving in a child who is having difficulty in clearing sputum. With postural

drainage and carefully applied vibrations, sputum can be successfully brought to the higher areas of the trachea, where it may cause spontaneous coughing, or it may be suctioned. Occasionally oxygen may be required and the indications for its use are cyanosis, extreme dyspnoea of respiratory origin or intermittent respiration with deterioration in the general condition. Children requiring oxygen are nursed in an oxygen tent.

### INTERMEDIATE STAGE

When the acute stage settles and consciousness returns the indications on whether the child needs further physiotherapy become apparent. Some children show spontaneous improvement with rapid return of function. Others, however, show obvious physical deficit and daily physiotherapy is necessary.

Assessment usually reveals that the child has lost its later patterns of movement and has returned to an earlier reflex stage. They do not always exhibit the typical patterns of spasticity associated with cerebral palsy. For example, in place of the usual adductor spasm these children are often abducted at the hip. Many of the children are hemiplegic. Tonic reflexes are not as apparent as in the more conventional cerebral palsied child, though primitive responses such as the Moro reaction may still be present in a child, who, but for being unconscious, would normally have grown through this stage.

The physiotherapist's aims are to inhibit abnormal movement patterns and to facilitate automatic reactions in order that the child may experience the patterns of movement associated with normal development. These aims are achieved in response to the physiotherapist's handling and positioning of the child.

The Bobath neuro-developmental approach to therapy has been found to be very useful in the management of these children, though, due to the diversity of symptoms, the approach is essentially eclectic.

It should be remembered that in this stage the child is still quite ill and treatment periods may have to be very short at first and progressed in length as the child improves. If the child is irritable, treatment should be abandoned for the day.

Treatment is directed to initially obtaining head control, which is the most important factor in the development of all other functions such as eye-hand control, visual acuity, rolling and balance. Rolling from supine, first over the affected side and then over the unaffected side, in the case of a hemiplegic, is obtained by the appropriate techniques of handling. In the prone position weight bearing is obtained in the upper limbs, first in the forearm support position, where weight transference from side to side is encouraged. This is followed by reaching out with one arm; this necessitates weight bearing on one limb whilst encouraging trunk rotation. Later, weight bearing is obtained on extended arms. As the child progresses sitting balance is obtained, first with support from the therapist and then with the arms in the forward supporting position. Weight bearing is then encouraged in sitting with the arms by the side. At this stage of sitting the child is encouraged to sit up in its cot holding on to the bars. After the "all fours" position has been achieved, crawling is encouraged; progression is then made to kneeling, standing and walking.

Unlike in the cerebral palsied child, response to treatment and recovery of function in the child with tuberculous meningitis is frequently rapid. This is most likely due to the fact that the child may be already grown through the "milestones" of normal development before the onset of the illness, whereas the cerebral palsied child has never experienced many of these. In addition, the nature of the brain dysfunction in tuberculous meningitis is transient in about 50% of the patients who recover.

Passive movements are continued if there is still the possibility of contractures occurring. Positioning and movements are better than splinting, especially where spasticity is present, because of the danger of pressure sores, but traction, plaster of paris or plastazote may be used with care.

### CONVALESCENT STAGE

The child is transferred to the convalescent ward at the stage of progress when it is no longer distressed by noise, when no further special nursing is required and when it is considered that contact with other children will be beneficial.

Physiotherapy is continued along the lines described and is aimed at obtaining the optimum functional ability in each child. Whilst a number of the children learn to walk satisfactorily without appliances, some do need calipers or special boots to hold the foot in a better position in order to develop an acceptable gait.

In the small proportion of children who are paraplegic, treatment is directed to strengthening the muscles of the trunk, shoulder girdle and upper limbs and teaching functional movements such as bed mobility and transfer activities. Those who are able, are given gait retraining and wheelchair activities.

### OCCUPATIONAL THERAPY

Occupational therapy is given to all children but mainly to those who cannot attend school. It consists chiefly of play therapy, hand craft activities and the use of educational toys.

### SCHOOLING

All children of about four years and above and who are able, attend school in the convalescent ward. The lessons are conducted by a teacher who is also a patient and she arranges the lessons to fit in with her own treatment and rest periods. The children receive about three hours schooling a day, half in the morning and half in the afternoon. Although the school is essentially along the lines of nursery schooling; the children are taught reading, writing and simple arithmetic. Singing is also a popular feature. This schooling in hospital does help to prepare the younger child for normal school when its treatment is eventually completed.

### AFTER CARE

All children with tuberculous meningitis have eighteen months of supervised treatment; this includes the time spent in the hospital and the T.B. settlement.

Specific treatment, i.e. I.N.A.H. (Neoteben), is continued by injection until the ward sister is satisfied that the child can swallow properly and the doctor is satisfied that the drug is being absorbed; thereafter the drug is given by mouth once a day.

Severely handicapped children stay in hospital to continue their treatment but those who can move around and are able to care for themselves are transferred to a T.B. settlement.

Lumbar puncture and cerebro-spinal fluid analysis is carried out for one year after the start of the specific treatment and, after transfer to the settlement, the children return to hospital at fortnightly and then monthly intervals for this.

Children needing renewal of appliances or orthopaedic consultation are seen in the hospital clinics and any corrective surgery that is required is carried out at King George V Hospital or any convenient hospital in the vicinity of the settlement.

There is good liaison between the hospital physiotherapist and the nurses at the settlement and any simple physiotherapy procedures which are still required are carried out by these nurses.

Schooling continues in the settlement and when the child's treatment is completed he is given a transfer card which allows direct entry into his local school without having to wait for a new term to begin.

The severely handicapped children remain in hospital until their treatment is completed. They are then usually discharged into the care of their parents. If a child is badly mentally handicapped the parents receive a single care financial grant to enable them to keep the child at home. Older severely handicapped children may have to be admitted to chronic sick hospitals or mental hospitals.

Judging from the results at King George V Hospital, it is estimated from the notified cases alone in the Republic of South Africa, i.e. 409 in 1974, and mostly black, that over one hundred children die in hospital and over one hundred and fifty become mentally and/or physically handicapped each year. However the problem is probably greater than it seems. It has been noted that some children who have apparently recovered completely with no obvious physical or mental deficit show emotional problems over and above those found in normal children. They lose their temper quickly and fight with other children, which creates difficulties at school, where they may fail their first two years. Eventually their employment opportunities may be impaired due to their quick temper, forgetfulness and lack of responsibility.

The management of tuberculous meningitis as carried out at the King George V Hospital, Durban, has been presented. There is no doubt that the many problems raised by this largely preventable disease add significantly to the load of the overworked and undermanned medical services in the Republic.

The government and local authorities are deploying a large proportion of their financial and manpower resources in combating tuberculosis. However it seems that the population as a whole is not yet sufficiently aware of the implications of this ever-present disease. Only a vigorous health education campaign and continuance of plan to open many more clinics so that treatment centres are within easy reach of patients anywhere, will bring it under control and, hopefully, lead to its eventual eradication.

### REFERENCES

1. Lincoln, E. M., and Sewell, E. M. (1963), *Tuberculosis in Children*—McGraw Hill, New York.
2. South Africa (Republic) Department of Health. Annual Report (1974).
3. *Tuberculous Meningitis in Children*. British Medical Journal (1971) 1, 1-2.

### ACKNOWLEDGMENTS

I wish to acknowledge the Department of Health for permission to present this paper at the Regional Congress of the Commonwealth Medical Association held in Maseru, Lesotho, in October 1975 and also for permission for its publication.

My thanks are due to Dr. W. C. M. Bulkeley, Mrs. E. Booth and Mrs. J. Currie of the King George V Hospital, Durban, for their help and encouragement in preparing this paper.