THE MANAGEMENT OF ACUTE POLIOMYELITIS*

C. J. KAPLAN, M.CH.ORTH., F.R.C.S. (ENG.), *Department of Orthopaedic Surgery, Addington Hospital, Durban*

There is no specific treatment for acute anterior poliomyelitis itself, but certain of the urgent complications which endanger life may respond successfully to special skilled care. The methods outlined below are based on the experience gained at the Children's Medical Centre in Boston, Mass., where over 700 cases of acute poliomyelitis were treated during the epidemic of 1955. I became acquainted with these methods during a visit to America in 1957.

The diagnosis of acute poliomyelitis is seldom, if ever, an orthopaedic problem and the treatment during the febrile phase is carried out by the physician or paediatrician, although the orthopaedic surgeon has daily access to all cases even during the period of isolation.

There is no contra-indication to a lumbar puncture if this is necessary in order to make a diagnosis. It is felt very strongly that a member of the orthopaedic staff should see the case before this is done, for lumbar puncture frequently makes subsequent orthopaedic examination very difficult.

An attempt is made to gauge the extent of paralysis and its rapidity of spread without disturbing the patient more than is necessary. Points to be looked for are:

(*a*) Slow progression of paralysis with little change is usually a good sign whereas rapid onset and spread of the paralysis carries a poor prognosis.

(*b*) Difficulty in holding up the head and weakness of the shoulders suggest that respiratory paralysis will occur from involvement of the phrenic roots.

(*c*) If muscle tenderness is present across the lower abdomen and in front of the thigh, paralysis of the whole of that leg is likely to develop.

(*d*) Close observation is kept of the progress, because it is important to know at all times, or to assess as soon as possible in the case of late admission, whether the illness is still in an active phase, in order to predict the outcome of the disease and to anticipate complications.

Paralysis commences 24-36 hours from the onset of the fever and continues for 24-36 hours. Once the temperature settles there is no further spread of paralysis and if the patient has not shown any evidence of grave complications by this time he will not do so in the future. The point to remember is that changes occur with startling rapidity in poliomyelitis and patients cannot be left unwatched; fatal respiratory failure may supervene within minutes. Once the temperature has been normal for 48 hours the danger of complications is well past and the case has entered the convalescent phase where every change is towards recovery.

During the acute phase of the illness, whether or not the patient develops complications, the principles of polio nursing must be enforced to the full. All beds or cribs must have full length boards with firm mattresses. A foot board is essential to help preserve good bed posture and prevent foot drop; a useful modification is the use of canvas tennis boots nailed to the foot board and into which the feet are laced loosely. This is more comfortable than metal bed splints along the whole length of both legs. A bed roll is usually placed under the knees in order to relieve tight hamstrings and a lumbar pillow will keep the back comfortable. Special nursing and posturing ideas have been worked out for the various regions of the body and aid materially in patients' comfort and posture.

With adequate nursing staff and the assistance of physiotherapists in the isolation wards, rigid splinting should be avoided; softer and more pliable posturing aids should be used.

There is no place for formal physiotherapy during the acute febrile stage of poliomyelitis. The physiotherapist under the direction of the orthopaedic surgeon and with the agreement of the physician may move joints passively in order to prevent stiffness. This is governed by the severity of the illness and the pain tolerance of the patient.

For muscle pain hot packs and aspirin appear to be the safest and most effective therapeutic agents. It has been argued that hot packs are not necessary in hot weather but there is no doubt about their value. Hypnotics should be avoided because they may mask premonitory symptoms of disaster.

During the febrile period isolation should be practised, with barrier nursing techniques. The hands of everybody who comes into contact with the patients should be scrubbed with Phisohex and not merely dipped into a basin of disinfectant solution. The best virocidal agent is thought to be tincture of iodine. As has been mentioned above, the period of isolation ends when the temperature has been normal for 48 hours.

It is the consensus of opinion in America that about 20-30% of hospital cases develop some severe complication, either bulbar poliomyelitis or respiratory paralysis.

COMPLICATIONS OF POLIOMYELITIS

The complications may be classified as follows:

A. *Bulbar Poliomyelitis*

1. Upper Cranial Nerve group: Paralysis of the 3rd, 4th, 5th, 6th and 7th nerves.
2. Lower Cranial Nerve group: Paralysis of the 9th, 10th, 11th and 12th nerves.
3. Respiratory Centre group
4. Circulatory Centre group } Respiratory insufficiency.
5. Encephalitic group

B. *High Cervical Cord Involvement*

6. Respiratory paralysis.

The above classification is merely a guide to the various types that may be encountered but it should be remembered that mixed types occur commonly. When this happens the treatment indicated for each type should be given.

Cranial Nerve Groups

1. *Upper Cranial Nerve group.* This involves only the facial muscles and the muscles of mastication. No difficult problems of management emerge. The prognosis is good and recovery is the rule.

2. *Lower Cranial Nerve group.* This is more severe because the muscles of deglutition are affected. The patient is unable to swallow and may aspirate food or secretions. Laryngeal paralysis with adduction of the vocal cords may obstruct the airway completely. These patients are terrified and require very careful handling.

Treatment. Constant suction and postural drainage are carried out even in a tank respirator. If secretions cannot be

* Based on a paper presented at the South African Medical Congress, Durban, September 1957.

controlled conservatively, then a tracheotomy is necessary. An important early decision is whether a tracheotomy will be required so that it may be done as an elective procedure, under an anaesthetic, and not as a desperate emergency on a suffocating patient. Absolute indications for tracheotomy are vocal-cord paralysis and infra-laryngeal paralysis resulting in elevation of the larynx against the base of the tongue.

Respiration through the tracheotomy tube can be spontaneous, by means of an intermittent positive pressure respiratory aid (I.P.P.R.) or pressure cycled i.e. with a tank respirator. In all cases the air must be humidified to prevent caking of the secretions in the trachea.

3. *Respiratory Centre Involvement*

This type is usually associated with involvement of the circulatory centre, which further endangers life. The patients are restless, apprehensive and cyanosed and they breathe irregularly with long periods of apnoea due to impaired discharge of stimuli from the respiratory centre. The condition has been likened to a 'fibrillation' of the centre.

Treatment. These patients fare badly in a tank respirator as they are unable to breathe in time with the machine, owing to the irregular outflow of stimuli from the respiratory centre. In fact a respirator will probably kill them. Attempts have been made to knock out the centre with large doses of morphia so that they will not fight the machine but these attempts have been unsuccessful. The patients require oxygen therapy *via* an intra-nasal catheter or by means of a tracheotomy if that is indicated. A regular breathing rhythm should be assured by means of an electro-phrenic stimulator, which blocks off all the irregular and ineffectual discharges from above. A tracheotomy may help here by eliminating much of the dead-space air and decreasing respiratory resistance. Prognosis in this type of case is very bad. Most cases die with pneumonitis and pulmonary oedema despite antibiotic 'cover'.

4. *Circulatory Centre Involvement*

These patients have a florid, dusky look and show evidence of cyanosis. They sweat profusely and are restless and develop hypertension up to about 200 mm. Hg with a low pulse pressure and hyperpyrexia to 106°F. One can do nothing to control their condition. They collapse suddenly and go into a state of shock. Practically all cases die and at autopsy are found to have had very severe haemorrhagic pneumonitis and pulmonary oedema.

5. *Encephalitic Group*

These patients show personality changes. They are very confused and suspicious and think the doctor intends to harm them. They complain of very severe headaches and stiff necks and backs, and commonly develop tremors and convulsions. Respiration becomes shallow and irregular, with periods of apnoea. It may be very difficult to differentiate these cases from those having respiratory-centre involvement, but it is important to do so because the treatment is different. If they respond to oxygen therapy, they are respiratory-centre cases. In the worst cases the temperature continues to rise, they become stuperose and comatose, and they die in convulsions.

Treatment. For respiratory insufficiency a tank respirator is the only thing that will save these patients. For the rest they require very careful nursing and sedation but this must be given with great care, for they can be knocked out quite suddenly. Prognosis in these cases is bad but certainly better than in the respiratory-centre group.

6. *Respiratory Paralysis*

Patients with this type of involvement can be differentiated from true bulbar polio by testing the function of the diaphragm and intercostals. If asked to whistle or blow against one's finger or to take a deep breath and count, the weakness is fairly obvious. If observed from the beginning, spread of weakness to the neck and shoulder girdle musculature will often give warning of a respiratory paralysis.

TREATMENT OF RESPIRATORY PARALYSIS

This consists of artificial respiration and it should be applied early, before the patient is in desperate need of air. Only a tank respirator is used in the acute phase, all other respiratory aids being of use only in the later phases of the disease. A working knowledge of the physiology of respiration is essential for full appreciation of the treatment of respiratory paralysis. Space forbids an explanation at this stage but many standard texts are available, or an anaesthetist colleague may be consulted.

Indications for the Use of a Tank Respirator

1. When a patient with some respiratory involvement is admitted in an exhausted state, as is often the case after a long journey by ambulance, he should be put straight into a respirator for a rest. Such a patient will often go straight off to sleep and on awakening will feel much better. He can then be taken out.

2. When the vital capacity is 50% of the predicted normal the patient should go into the respirator for a trial or for rest periods, and should sleep in the respirator during the early stages of the disease to avoid the swift and silent approach of disaster when no warning is possible.

3. When the vital capacity is reduced to 33% of the predicted normal the patient should remain in the respirator until he recovers a safe tidal volume.

Being put into a respirator can be a very frightening experience and psychological preparation is most important.

Methods of Assessing the Need for Artificial Respiration

Arythmia of the respiratory centre or incoordination of muscular activity do not of themselves require artificial respiration. The only absolute indication is hypoventilation and the only exact method of testing this is by alveolar air estimations and arterial oxygen and carbon dioxide saturation curves. These techniques must be carried out in a laboratory and are not practicable in the severely ill patient.

In practice one measures the vital capacity with a spirometer and estimates its efficiency as a percentage of a predicted figure. A rough estimate of the predicted vital capacity can be made from the following table:

	5-15 *years*	*Over* 15 *years*
Males ..	250 c.c. per year of age	25 c.c. per cm. of height
Females ..	200 c.c. per year of age	20 c.c. per cm. of height

The results obtained by this method will be an adequate guide to whether a patient requires respiratory assistance. Once it has been decided that the use of a tank respirator is necessary the required tidal volume can be estimated accurately from Radford's nomogram[1] (Fig. 1) and the settings of the machine can be adjusted accordingly. Finer adjustments can be made after accurate biochemical analysis, if this appears necessary. The whole purpose of artificial respiration is to

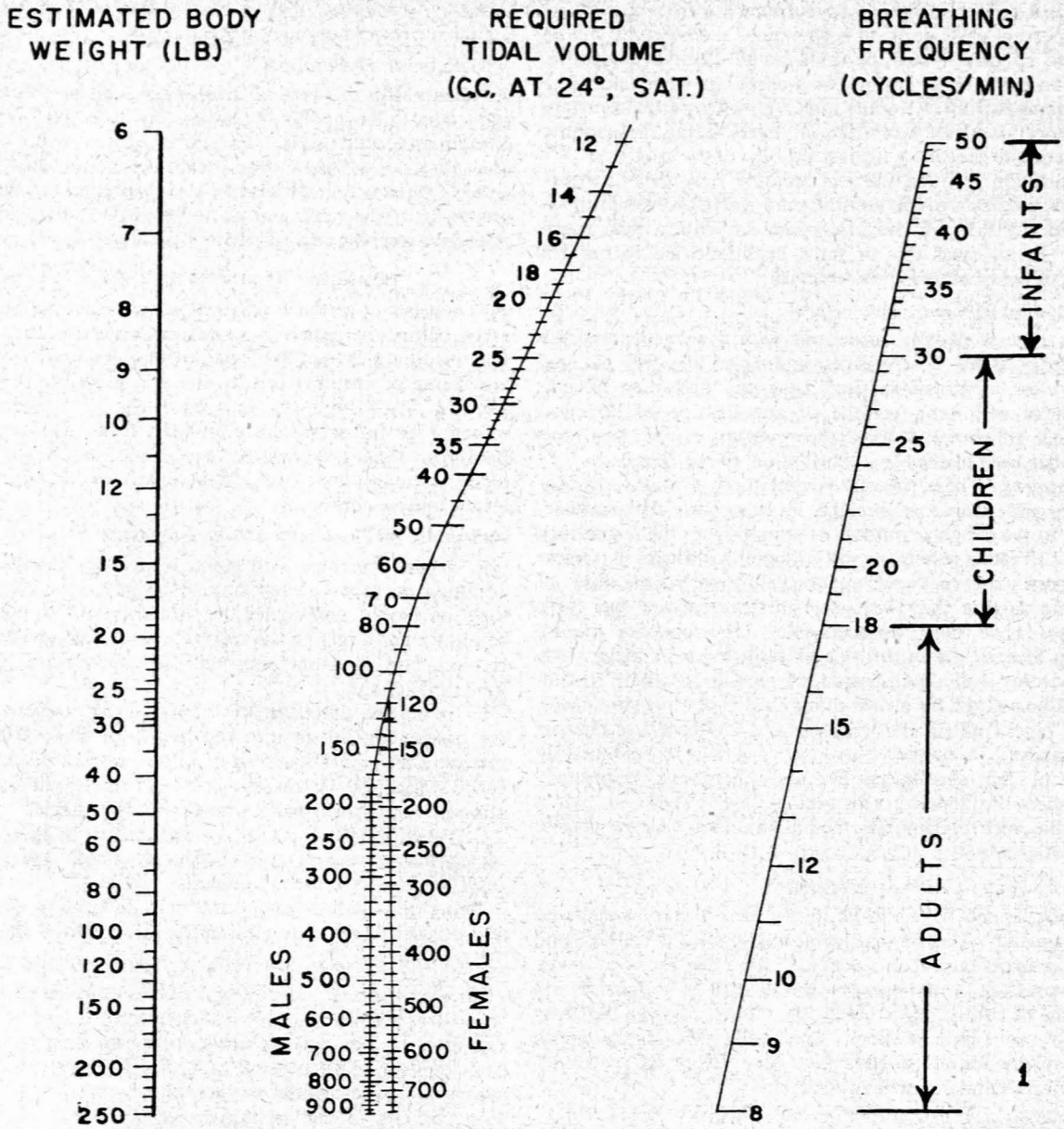

Fig. 1. Ventilation nomogram to be used in estimating the adequacy of tank respirator settings (after Edward P. Radford, Jr., M.D., Department of Physiology, Harvard School of Public Health).

Determine the required tidal volume from the nomogram plus corrections; then adjust tank pressure or frequency until the average measured tidal volume equals the predicted value.

Correction factors to be applied to tidal volumes obtained from nomogram:

Daily activity and eating: Add 10%

Fever: Add 5% for each °F above 99° (rectal)

Altitude: Add 5% for each 2,000 feet above sea level.

Tracheotomy: After all above corrections have been added, subtract a volume equal to ½ the body weight.

get rid of the excess CO_2 in the blood, the hypoxia being of secondary importance. CO_2 retention causes acidosis and upsets the whole electrolyte balance, but once the CO_2 level is controlled the electrolytes assume their normal proportions, although some initial assistance may be necessary.

General Measures

All patients with respiratory embarrassment should receive antibiotics in order to prevent the development of pneumonia. When necessary, the electrolyte balance must be adjusted with whatever ions are indicated. The importance of posturing and the control of secretions have been stressed. The general nutritional state should not be allowed to lapse too far.

Emergency Measures and Equipment

It is essential that everyone who works with acute poliomyelitis patients should be able to recognize the warning signs of complications and trained to act accordingly. They

must all understand the working of tank respirators and be capable of using an emergency hand bellows if necessary.

The following items of equipment should always be available in the ward and in full working condition. Under no circumstances should 'borrowing' be allowed:

(1) Tank respirator, (2) bellows resuscitator, (3) tracheotomy set, (4) bronchoscopy set, (5) suction machine, (6) laryngoscope tray with airways and endotracheal tubes, (7) oxygen, (8) a spirometer with disposable mouthpieces, and (9) an electro-phrenic stimulator. Furthermore, when acute cases are in the ward a doctor should always be *within call*—being *on call* is not sufficient, because minutes may make all the difference.

SUMMARY

Methods of handling cases of acute poliomyelitis are described.

The complications of bulbar poliomyelitis are classified and the essentials of treatment outlined.

The indications for artificial respiration are given and methods of assessing the predicted vital capacity and required tidal volume are shown. Radford's nomogram is reproduced.

Emergency equipment is listed.

REFERENCE

1. Radford, E. P. *et al.* (1954): New Eng. J. Med., **251**, 22.