was semi-comatose and delirious and had fairly marked meningeal signs. In two days she became completely comatose and did not recover full consciousness till after a month, by which time she had a right hemiparesis. Her progress thereafter was slow but steady. During the fourth month of treatment she became deaf: her deafness was moderate and never became complete. A month later her condition deteriorated, spinal block developed, and she died on May 2, 1951.

Case 8.—A man aged 24 was admitted on January 19, 1951, with bilateral pulmonary tuberculosis complicated by tuberculous meningitis. He was irrational and resentful and had marked meningeal signs. Pneumoperitoneum was induced to control the pulmonary tuberculosis, which appears to have healed. His progress was slow, but by the end of the fifth month signs and symptoms had subsided and his temperature had settled. Then he developed slight impairment of hearing, which has now become moderate. Otherwise he is fit, the chest having cleared and the C.S.F. returned to normal.

Conclusions

The results in this series contrast with those outlined by Cathie and Garrow (1951). Their results with dihydrostreptomycin were poorer than those obtained earlier. In the present series the recovery rate with dihydrostreptomycin was 67%, as compared with 50% prior to its use. Other factors, however, have probably contributed to the improvement in results—increasing knowledge and experience of streptomycin, concomitant administration of P.A.S., etc.—and it is doubtful whether any significance can be attached to it. It seems reasonable to deduce, however, that dihydrostreptomycin is at least as effective as other forms of streptomycin in the treatment of tuberculous meningitis.

The series confirms the findings of Cathie and Garrow and other workers in relation to deafness. In contrast with 1 case of deafness out of 13 survivors before the use of dihydrostreptomycin, 50% of survivors became deaf after using this drug. The occurrence of nerve deafness late in the course of treatment in most cases, when the patients appeared to have recovered from the disease and were normal in other respects, suggests that the deafness is unlikely to be caused by the meningitis, but that it is a toxic manifestation—apparently irreversible—of the drug used. It is true that in this series other factors may have contributed to the increased incidence of deafness with dihydrostreptomycin, especially the increased intrathecal dosage of the drug in the second group of cases, but there is enough evidence to warrant caution in using dihydrostreptomycin, and to indicate a controlled investigation of its advantages and disadvantages compared with other forms of streptomycin.

Summary

The results obtained in a series of 26 cases treated with streptomycin are compared with those in a series of 51 cases treated with dihydrostreptomycin. While the latter showed a 67% recovery rate as compared with 50% in the former, 50% of the survivors in the second series were deaf, whereas only 1 out of 13 survivors in the first series had impairment of hearing.

Some of the features of the deafness are stated, and brief descriptions are given of some illustrative cases.

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ADDENDUM.—Since this paper was submitted for publication one further case in Group 2A has developed slight deafness, and four more cases in Group 2B—making a total of six cases in this group—have become deaf. These facts confirm the conclusions already reached and stated above, and are in keeping with papers which have appeared more recently. It is hoped to incorporate these further results in a later publication.

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GROWTH OF BIPARIETAL DIAMETER OF FOETAL HEAD IN THE LAST WEEKS OF PREGNANCY

BY

I. MACDONALD, M.B., B.S., D.Obst.R.C.O.G.

(From the Department of Physiology, Guy's Hospital, London)

Those who favour the early induction of labour for the prevention of cephalo-pelvic disproportion base their practice on the beliefs that during the last weeks of pregnancy the foetal head becomes harder and larger. The second of these two beliefs has been questioned by Josephs (1949), who could not detect radiologically any increase in the biparietal diameter during the last four weeks of pregnancy. This paper is concerned with examining this rather surprising finding.

Methods.—Steel callipers (Fig. 1) fitted with a sprung platform so that measurements could be made under standard conditions of pressure were used to measure the biparietal diameter of infants' heads 48–96 hours after birth.

Results

The individual biparietal diameters of 1,059 infants were plotted against the respective durations of pregnancy as estimated from the first day of the last menstrual period of the mother. A statistical calculation was then made to delimit the area within which two-thirds of all these points fell. This area is represented by the shaded portion of Fig. 2, from which it can be seen that in general the greater the duration of pregnancy the greater the biparietal diameter of the head. In addi-

FIG. 1.—Sketch of callipers used in measuring the biparietal diameter of the head, showing the sprung platform.

tion to these 1,059 infants delivered as a result of the spontaneous onset of labour, a further series of measurements of 24 infants delivered after an induced labour during the 35th-38th weeks of pregnancy was made. These results are shown in Fig. 2. It may be noted that 15 out of 24 fall within the shaded area, whilst the mean of these 24 measurements is slightly less than that for babies of a comparable age born spontaneously. The relevance of this finding will become apparent later.

FIG. 2.—Graph showing area delimiting two-thirds of all measured biparietal diameters plotted against estimated duration of pregnancy. The open circles indicate biparietal diameter of heads of infants in which labour was induced before 39 weeks from the last menstrual period.

FIG. 3.—Hypothetical growth curves of the biparietal diameter of the foetal head. The continuous line represents the mean biparietal measurements at birth of 1,059 infants; it is in fact the mean line representing growth in this diameter. The broken lines with open circles show how the final mean measurements could be reached even if no growth took place in the last four weeks. This possibility has been excluded (see text).

FIG. 5.—Diagram showing the shape of the plane of the biparietal diameter with circumscribed circle.

weeks before birth the biparietal diameter of each foetus stopped increasing, no matter whether it was born at 34 or 42 weeks by dates; it also implies that the date of labour was ordained at least four weeks in advance. At its face value this suggestion does not seem likely, but it would reconcile the findings of Josephs with those stated in this paper.

Discussion

The common-sense conclusion suggested by Fig. 2, that the biparietal diameter continues to grow in the last few weeks of pregnancy, is not inevitable. Each baby was measured only once, and it is possible that had each head been measured a month earlier it would have been the same size as it was when actually measured—that is, the growth curve of Fig. 2 may have been produced as shown in Fig. 3. This is tantamount to saying that four

weeks before birth the biparietal diameter of each foetus stopped increasing, no matter whether it was born at 34 or 42 weeks by dates; it also implies that the date of labour was ordained at least four weeks in advance. At its face value this suggestion does not seem likely, but it would reconcile the findings of Josephs with those stated in this paper.

To settle the matter it would be necessary to measure the biparietal diameter of the foetal head at 36 weeks and again at 40 weeks. This is not possible, but the line of argument set out in Fig. 3 would imply that pregnancies terminated artificially two to four weeks before the expected date of delivery would produce babies in whom the ratio of biparietal diameter to age was higher than that of babies born naturally. The distribution of the open circles in Fig. 2 clearly indicates that the biparietal diameters of infants born after induction are not systematically different from those of infants born spontaneously at an equivalent period of pregnancy. Thus there is no doubt that the biparietal diameter does increase in the last four weeks of pregnancy. The mean magnitude of this increase is shown in Fig. 4, which is a life-size drawing of the mean circumference of the plane drawn through the bregma, subocciput, and both parietal eminences at 36 and at 40 weeks.

It now remains to inquire why Josephs did not detect the increase of the biparietal diameter of the head which takes place in the last four weeks of pregnancy. The radiological method of measurement of the biparietal diameter assumes that the largest plane at right angles to the longest diameter of the skull is a perfect circle. This assumption is demonstrably false, as may be seen from Fig. 5, which shows the shape of the plane of the biparietal diameter with a circumscribed circle for comparison. The question therefore arises, does any event in the last four weeks of pregnancy give this false assumption a special significance in the measurement of the biparietal diameter which is not present earlier? Clearly one factor which must be taken into account is the descent of the head with the concomitant backward shift into the pelvic cavity. Because the plane of the measurement is not a circle a systematic change in the position of the axis of the foetal head in relation to the pelvis, and therefore

FIG. 4.—Actual size of the circumference of the average foetal head normally presented to the birth canal at 36 and at 40 weeks, showing increase as measured after delivery.

to the source of x rays, could produce a systematic difference between the measured and the true biparietal diameter.

This possibility has been put to the test by outlining the shadows thrown by three near-term foetal skulls in various positions relative to a source of light and then measuring the widest diameter at right angles to the longest diameter of the shadow. This measurement, with suitable corrections, is that used radiologically to determine the biparietal diameter. The measurements of the shadows showed that a difference of 4 mm. between the true and estimated biparietal could be produced—a significant difference in view of the fact that the mean growth of the biparietal diameter of the head from 36 to 40 weeks is also 4 mm. This observation could account for the failure to record by radiological means growth up to 4 mm. of the biparietal diameter during the period of descent of the foetal head.

Summary

The biparietal diameters of 1,059 newborn infants have been measured and plotted against the estimated duration of pregnancy.

Growth in this diameter of the foetal head occurs in the last few weeks of pregnancy.

An explanation is offered for the failure to detect by radiological means growth of the biparietal diameter of the foetal skull during the descent of the foetal head.

I wish to express my appreciation for the help given to me by the medical and nursing staff of Queen Charlotte's Hospital and of the maternity wards of Lambeth and Guy's Hospital.

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POLIOMYELITIS IN MOTHER AND NEWBORN INFANT

BY

G. A. WRIGHT, M.B., Ch.B., M.R.C.P.

AND

T. K. OWEN, M.B., Ch.B., M.Sc., M.R.C.P.

(From the Royal Victoria Hospital, Bournemouth)

The rarity of poliomyelitis during the first month of life prompts us to record the following case. Severin (1939), in a review of the literature, was able to find only 22 cases that occurred in the first month of life, while Baskin *et al.* (1950) could find only 10 cases in the first fortnight, which they consider the newborn period. They reported two further cases; in one the illness began on the fourth day of life and death occurred on the seventh, and in the other the illness began on the ninth day and death occurred on the fifteenth.

Our cases are those of a mother and child who were victims of poliomyelitis during the 1950 epidemic.

Mother's History

A married woman aged 21, in the 37th week of her second pregnancy, nursed her sister-in-law for a period of six days until the latter was admitted to an isolation hospital with poliomyelitis. Nine days later she felt tired and developed a headache. The next morning, on attempting to rise, she found that her legs were weak and that she was unable to stand. At 10 o'clock the same morning uterine contractions began, and she was admitted to hospital.

On admission her temperature was 99° F. (37.2° C.), pulse 100, and respirations 20. Labour proceeded normally, and

the paresis involved the legs only. A male child weighing 7 lb. 4 oz. (3.3 kg.) was delivered normally at 7 p.m. after a quick second stage. At 8 p.m. she was noted to be dyspnoeic, with rapid shallow respirations, cyanosis, and pallor. Her temperature was subnormal, pulse 160, and blood pressure 140/80 mm. Hg. A small post-partum haemorrhage occurred before the completion of the third stage. She was given oxygen, but it became necessary to place her in a respirator at 1.30 a.m. the following day. By this time the muscles moving both hips, knees, and shoulder-joints, and the lower intercostal muscles, were all paralysed, but she was able to talk and swallow. The uterus was firmly contracted.

On the first day after delivery the temperature was 103° F. (39.4° C.) and pulse 100–130. She was given procaine penicillin prophylactically. The temperature fell to normal at the end of the third day after delivery, and remained normal. The pulse, however, was still between 120 and 140, finally rising just before her death on the fifth day after delivery.

At the post-mortem examination the lungs were moderately oedematous and congested. The stomach and intestines were very distended, chiefly by gas. The uterus showed normal involution. There were no other significant changes to the naked eye. Sections taken from the spinal cord and medulla showed the characteristic changes of poliomyelitis. A portion of the myocardium was taken for section, but foci of inflammation were not seen.

Infant's History

The infant was separated from the mother immediately after birth, and was kept isolated from her. He appeared well, with normal muscular power, and took his feeds until the eighth day, when he refused two feeds. His weight was then 7 lb. 12 oz. (3.5 kg.)

On the ninth day feeding remained poor, and the left arm movement was diminished. On the tenth day feeding became more difficult, though he was able to swallow food from a spoon at 10 a.m. The weight was 7 lb. 8 oz. (3.4 kg.). Later the same morning movements of the arms were completely absent, although a weak grasp reflex could still be obtained on the left side. No arm-jerks could be elicited, but the knee-jerks were present and equal. The baby rapidly became increasingly listless, and cyanosis developed. The intercostal paralysis was complete by 1 p.m. and swallowing became impossible. Oxygen therapy was given, but death occurred at 7 p.m.

A specimen of cerebrospinal fluid obtained immediately after death showed: 356 leucocytes per c.mm. (95% lymphocytes and mononuclear cells, 5% polymorphonuclear cells); total protein, 130 mg. per 100 ml.; albumin and globulin both increased; sugar, 50 mg. per 100 ml.; chlorides, 720 mg. per 100 ml.

The post-mortem examination revealed congestion of the spinal cord and brain. The heart and other internal organs showed no abnormality to the naked eye. Sections were taken at varying levels from the dorsal and cervical cord and brain stem. All showed foci of inflammatory infiltration almost entirely by polymorphonuclear cells, and in the cord chiefly in the anterior horns. Most motor-nerve cells had disappeared, but a few could still be identified in a degenerate state. There was some lymphocytic infiltration of the meninges around the cord. Similar lesions were also present in the medulla, pons, and thalamus. A section taken from the left ventricle showed some evidence of myocarditis, indicated by a very occasional focus of necrosis and infiltration by inflammatory cells, macrophages, and polymorphs.

Discussion

A record is here presented of a baby who developed poliomyelitis on the eighth day, born of a mother who developed poliomyelitis the day before delivery. The incubation period of poliomyelitis is generally believed to be about 10 days, but it may be as short as five. Although