information is available, and therefore ought to be undertaken primarily by clinicians rather than by statisticians. Some knowledge of statistical methods is useful, but it is much more important to tabulate accurate information sensibly and to interpret trends with insight than to calculate precisely the vagaries of chance among data which may be neither accurate nor meaningful.

Impaired Foetal Oxygenation

Finally, what is the cause of "mature, cause unknown" death and of foetal distress during labour? The association with post-maturity and the fact that anoxia is a common finding at necropsy suggest that impaired oxygenation of the post-mature foetus may be the immediate cause. This is supported by the work of Barcroft and Young (1945) on animals. Walker (1954) has undertaken a study of the oxygen content of human foetal blood and has found that the percentage saturation—that is, the content in relation to the capacity—falls after term in normal pregnancy, and is unusually low where there is foetal distress and in a second labour in cases in which the first pregnancy ended in a "mature, cause unknown" death. These findings confirm the hypothesis that impaired foetal oxygenation is the main reason for the excess foetal mortality after term; presumably the basic reason has to do with a decline in the functional efficiency of the placenta when pregnancy is unduly prolonged. We have yet to determine whether the high obstetric death rate in elderly primiparae is due to exceptionally low foetal blood-oxygen levels or to normal levels together with foetuses of low general vitality; it is not due to an unusually high incidence of post-maturity.

Summary and Conclusions

The study of morbidity and mortality statistics requires detailed clinical knowledge and good clinical case records if it is to be most fruitful. Statistics of maternity present many natural advantages for such a study, which should preferably be based on an administrative area. The scientific value of the traditional annual reports compiled by maternity hospitals is extremely limited.

The epidemiological approach in obstetrics is useful in providing insight into the nature and means of prevention of conditions which cannot be fully understood by detailed study of the individual case. Besides providing perspective, epidemiological research in a clinical unit increases precision of clinical observation, improves the quality of case records, suggests fruitful lines of laboratory investigation, and provides the means of checking the results of treatment.

The approach is illustrated by researches into the nature of unexplained stillbirths and first-week deaths in Aberdeen.

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THE TREATMENT OF SUBACUTE AND CHRONIC SUBDURAL HAEMATOMAS

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Wilfred Trotter (1914) recognized that some of the poor results in treating chronic subdural haematomas were due to failure of the brain to expand after their evacuation. This observation has been confirmed many times. The head-down position, intravenous fluids, and drainage of the subdural space have been used to help the brain to resume its volume after removal of the compressing mass. LaLonde and Gardner (1948) showed that better results were got when saline was injected into the subarachnoid space to help the brain to expand. Since then no other series of cases so treated has been reported.

Details of Treatment

It is common practice to seek and treat subdural haematomas by making burr-holes in the skull. There is no value in raising an osteoplastic flap, and it may be detrimental. Improved methods of diagnosis have precluded cases in which a subdural haematoma was a surprise finding at craniotomy for a cerebral tumour.

The making of burr-holes is always done under local analgesia, no matter how restless the patient. The usual site for the initial burr-hole is in the mid-temporal region about 1½ in. (4 cm.) above the zygoma. Further burr-holes may be made in the frontal and parietal areas. The most useful site for the second burr-hole is in the posterior parietal region. While a fluid haematoma can be easily treated through one burr-hole, a clotted haematoma needs multiple explorations. Bilateral burr-holes are always made, as the haematomas are bilateral in many cases. Incision of the dura mater will allow the haematoma contents to gush out. A fine rubber catheter is introduced into the subdural space in all directions and irrigation is carried out gently with Ringer's solution, which is preferable to normal saline. The washing is continued until the returning fluid is clear. In favourable cases the brain will expand to fill the dead space left by evacuation of the haematoma. The skin incision is closed in two layers and no drainage tubes are inserted.

The intrathecal injection of Ringer's solution is used in every case in which the brain does not expand after removing the haematoma. Ringer's solution can be injected into the lumbar subarachnoid space or into the ventricles of the brain by way of one of the burr-holes. Ventricular injection may be difficult if the ventricles are collapsed, and some experience is needed for ventricular puncture. Lumbar puncture is easier, and is safe and effective. When the haematoma is unilateral the towelled patient is not greatly disturbed on being turned from the supine to the lateral position for lumbar puncture. It is unsatisfactory, however, to turn patients with bilateral subdural haematomas. This difficulty has been overcome by operating with the patient in the prone position. The head is held in a cerebellar head-rest, which is adjusted to the patient's comfort, no flexion of the head being needed. No respiratory embarrassment occurs in this posture if the chest is raised on the shoulder-pieces, as the tongue cannot fall back into the pharynx. The lumbar-puncture needle may be inserted before the burr-holes are made. The prone position gives good access to all parts of the head except the forehead. It is satisfactory also for making burr-holes in cases of acute head injury. The patient is in an ideal position if the posterior fossa has to be explored for a haematoma.

Between 50 and 200 ml. of Ringer's solution will be needed for brain expansion. The injection should be continued until the brain is in contact with the edge of the burr-hole. A recent case of bilateral subdural haematomas of infancy had 160 ml. of fluid injected by lumbar puncture without any adverse effect. When a single burr-hole is used as a means of treatment it is better to leave the catheter as a vent over the convexity of the brain until expansion has removed surplus fluid and air from the subdural space.

The after-treatment consists in keeping the patient flat and maintaining a good fluid intake. When the inflation method has been used it is desirable to do a daily lumbar puncture for at least four days. If the cerebrospinal fluid pressure is below 150 mm. H_2O Ringer's solution is injected to raise the pressure to this level. The state of consciousness and the absence of headache are reliable guides to clinical improvement.

Clinical Material

Twenty-eight cases of subacute and chronic subdural haematomas have been treated in the neurosurgical unit at Dunedin Hospital. Subdural haematomas of infancy and one case of chronic subdural haematoma in a child of 5 years with a successful outcome are excluded from the series. The subacute haematomas occurred between seven and twenty-one days of a known head injury. The chronic haematomas had a latent period of over three weeks, or a history of previous injury was unobtainable. The ages of the patients ranged from 17 to 77 years.

No fresh observations can be added to the well-known clinical picture. Many patients were seriously ill and had come long distances—often up to 500 miles by air ambulance. Eighteen had had lumbar puncture, mostly in other hospitals, and eight were made much worse by this procedure. In most cases the information gained by lumbar puncture did not materially assist in the diagnosis, and its danger in these cases cannot be too greatly stressed.

The diagnostic procedure of choice was carotid arteriography. When an arteriogram indicated a haematoma, an examination of the other side was not inflicted upon the patient, and a subsequent burr-hole was used instead. If the previous head injury was clear-cut or the condition of the patient with suspected haematoma was parlous, immediate burr-holes were preferred to any other diagnostic method. We have been reluctant to use arteriography in patients over the age of 65, and have not used it at all in those over 70. At this age there are few alternatives in the diagnosis of subdural haematoma, and the making of burr-holes is a benign matter.

In 1952 it was decided that the inflation method should be used whenever the brain did not expand after removal of the haematoma. Ten patients come under the old regime and 18 are in the new group. In 14 of the latter inflation was used. The subdivisions showed the same degree of neurological severity. However, there were four patients over 70 years and three with bilateral haematomas in the later group. This 10% incidence of bilaterality is at variance with the 30% incidence in most other series.

There was one death, and that was in the first group. The patient was a semi-comatose man who died 24 hours after burr-holes had been made. The necropsy showed that the brain had not expanded. Inflation might well have saved him.

The outstanding difference between the two groups was in the degree of recovery. Under the old regime, patients often remained confused and had headaches for several days—sometimes a week or more—and during that time gave cause for concern. There was one recurrence, and that was dealt with successfully. The new method brought a more rapid return to full consciousness. This improvement was often apparent on the operating table, and the post-operative period was less worrying. It was common for the headaches to disappear from the time of inflation. The greatest advantage was in elderly patients, who seem to be prone to develop dehydration and intracranial hypotension. While it is impossible to be dogmatic, it is felt that a fatal issue was averted in several cases by the use of inflation. No ill effects from this treatment were seen.

When inflation was first used it was hoped that a single injection would be enough and that recurrences would be avoided. There were two patients over 70 years who made a dramatic improvement for a few days and then suddenly relapsed: further collections of fluid were successfully treated. Experience has shown that the only way to prevent recurrences is to do a daily lumbar puncture and to keep the C.S.F. pressure at 150 mm. H_2O by further injection as recommended by Munro (1952). The minimum period for this procedure is four days, and it must be continued until the patient's condition has stabilized.

Six patients had their inflation done by lumbar puncture and six had direct ventricular injection. The other two had combined lumbar and ventricular puncture. There is nothing to choose between the results of each method.

Discussion

The conclusions of LaLonde and Gardner (1948) on the value of injection of normal saline into the subarachnoid space or ventricles in the treatment of subdural haematomas are confirmed; but they did not give their results before using the method. Munro (1952) recommends the same treatment for all types of subdural haematoma. His use of repeated lumbar puncture to sustain the C.S.F. pressure is essential if recurrences are to be prevented.

The critical features in the train of events initiated by a subdural haematoma are compression of the brain, tentorial herniation by the temporal lobe of the brain, and intracranial hypotension. Jefferson (1938, 1951) has given good reviews of tentorial herniation, and intracranial hypotension has been reviewed by Page (1953) and Holmes (1953). In many cases removal of the haematoma leads to immediate expansion of the brain and rectification of these three complications; but they may persist singly or in combination and be responsible for a slow recovery or a fatal issue. The method of expanding the subarachnoid space and the cerebral ventricles, and also the brain, will counteract these adverse features. So long as there are no irreversible changes, the mortality should be lower and convalescence more rapid than with mere evacuation of the haematoma. This series, however, is too small for dogmatism regarding the mortality, though there is no doubt about the improvement which occurred in the recovery period when the injection method was used.

The method of brain expansion, whether ventricular or lumbar, does not make any difference to the end-result. The lumbar route is the easiest for the less experienced. The use of the prone position for the patient is an advantage for lumbar puncture and for access to the head.

Summary

The treatment of subacute and chronic subdural haematomas by the injection of Ringer's solution into the lumbar theca or cerebral ventricles is advocated.

Comparison is made between 10 cases before and 18 cases after this method was used.

Some of the pathological features of subdural haematoma are discussed in relation to treatment.

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