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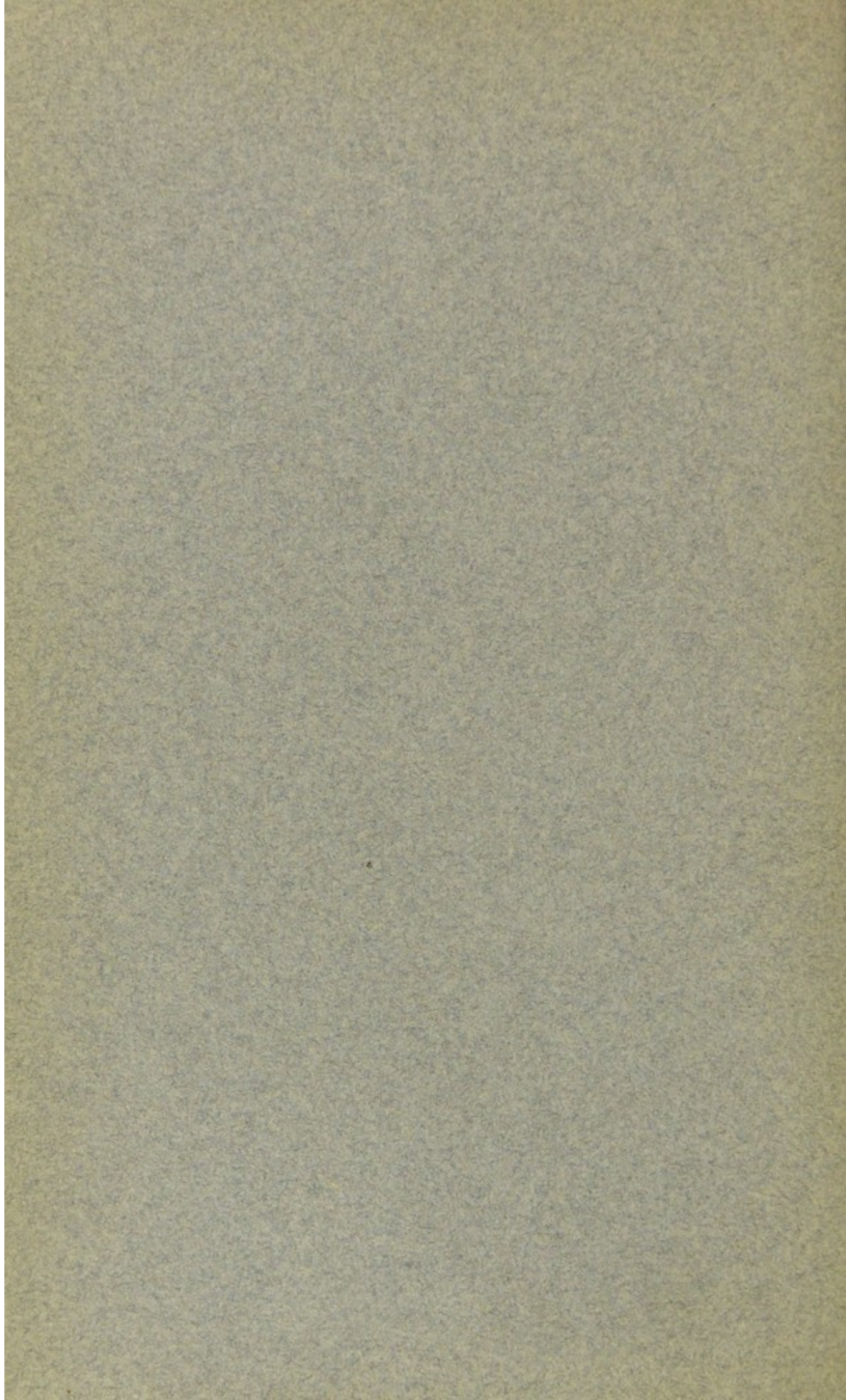
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THE OPERATIVE TREATMENT OF SPINA BIFIDA. A Report of 24 Cases.

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The modern operative treatment of spina bifida has received but scant attention at the hands of American surgeons, most of the literature consisting of the reports of isolated cases or of small groups. The following group of personal cases is here presented for analysis because, small as it is, it is larger than any single group that the writer has been able to find analyzed after a careful search of the literature of the last ten or more years, and although the analysis of small groups of cases is always dangerous and apt to be misleading, the results of analysis of this group agree so closely with the results of other operators that it seems warrantable to draw certain general conclusions from them.

OPERATION.—The former operative procedures of tapping, ligation, the injection of irritant fluids and the like, are no longer discussed as they were at one time, and a radical operation has taken the place of these unsatisfactory and often dangerous methods. The operators who have reported the larger groups of cases are in general agreement as to the operation to be performed although differing a little as to detail. Other operations are as a rule reported in connection with a smaller number of cases and have as yet no established place in general surgical practice. Such proceedings are, making a bony covering to the opening in the canal by breaking in the spinous process, inserting celluloid plates or pieces of bone in the opening in the spinal canal, etc.

The operation which was performed in the series of cases to be reported is quite in accord with the methods of the operators of the largest experience. The operation consists of four stages.

1. An incision somewhat longer than the sac is made at the base of the sac as near the median line as the character of the skin covering the tumor permits. It is not advisable to make an incision through bluish and badly nourished skin but to make it as far out as is necessary in order to secure healthy edges to be brought in contact. The incision is first made through the skin and then the sac is opened freely by a long longitudinal incision made at the same location as the skin incision. There is apparently no danger to be anticipated from allowing the spinal fluid to escape rapidly, and although in the earlier cases many precautions were taken to prevent the rapid escape of the fluid in no case has any serious collapse resulted from the later method of rapid evacuation. A similar incision is then made on the other side of the tumor through skin and sac, and the sac is turned inside out for inspection. Any nerves which are found on the inside of the sac are carefully dissected off and reduced into the spinal canal. The sac is then cut away, leaving an elliptical hole, at the bottom of which lies the neck of the sac. Resection of the cord and end to end suture has been performed by Murphy in central dilatation of the cord.¹

2. The second step in the operation consists in the closure of the sac and its reduction into the spinal canal. The neck of the sac is dissected free, well down into the opening in the spinal canal just as the neck of a hernial sac is freed before reduction into the inguinal canal. As much of the neck of the sac as seems advisable is cut away and the opening closed by an over and over, or by a purse string suture of fine silk threaded on cambric needles. It is most important that no leakage of spinal fluid should occur and an efficient closure of the neck of the sac is most important.

3. The third step in the operation consists in furnishing a firm layer to close the superficial opening. Without this a bulging is likely to occur in the sac and a partial relapse follows. This was demonstrated in one or two of the earlier cases where the flaps used were of insufficient strength. A quadrilateral flap with the base toward the middle line is then made through muscle and fascia somewhat longer than the opening in the spinal canal and of sufficient width to meet without great tension.

These flaps are then inverted and sewed together by a close continuous suture of fine silk so tightly as to prevent any leakage from the spinal canal. It is important to fasten the top and bottom of the flaps to the underlying tissues, sealing the opening firmly against intra-spinal pressure. In the sacral region there is, of course, no muscle to be used for this purpose and a thin periosteal flap must be made which is treated in the same way as the flap of fascia and muscle.

4. The last stage of the operation consists in the closure of the skin incision. A continuous suture of chromicized catgut is used for this purpose threaded on an ordinary surgical needle, bringing the flaps closely together, and this suture is re-enforced by a few interrupted silk-worm gut sutures. It is important to prevent inversion of the edges of the skin and if the tension is sufficient to whiten the lips of the wound the suture should be removed and one exerting less tension inserted.

In the case of very large tumors the edges of the skin incision will not meet and in these cases it is necessary to make two long longitudinal incisions in the flank, to dissect up the skin and subcutaneous tissue as far toward the middle line as possible without opening into the sac, and then to slide in the two flaps of skin which will thus meet without tension, leaving an elliptical raw surface to granulate in each flank. This procedure apparently adds to the danger of the operation.

An antiseptic dressing is then applied fastened in place by a snug swathe. Over this it is advisable to put another and independent dressing which can be changed when it becomes soiled without exposing the wound to the danger of infection by too frequent dressings. The conditions are not particularly favorable for strict asepsis. An ulcerating surface is frequently present at the apex of the tumor; the skin which must form the edges of the flaps is frequently thick and macerated by the contact of the base of the tumor and the skin of the back; and dressing must be undesirably frequent as it is very difficult to keep urine and feces from getting into the dressing in cases where the tumor is situated low.

A superficial infection has been seen in a few of the cases

reported in this series which in no case has proved serious and no instance of breaking down of the wound or of serious sepsis has been encountered.

The points in the operation which would seem to be of the greatest importance are as follows:

1. Rapidity. A capital operation upon a new-born child or a child in early infancy should not if possible take more than half an hour. After this, shock of a serious character is likely to supervene and it is most desirable that the operative technique should contribute in every way to rapid work. In no case in the present series has the operation taken longer than three-quarters of an hour and of late it has been possible to finish in thirty minutes or less. The child should be protected against the loss of heat, and during the operation should be surrounded by hot water bags and only the operating field exposed. It is not as a rule necessary to tie vessels as no arteries of any considerable size should be opened and packing with loose gauze is generally sufficient to control hemorrhage which should be reduced to the lowest possible amount.

2. The second point in the operation consists in the careful dissection of the nerves from the interior of the sac. Cases have been reported in which paralysis has followed the operation and it is obvious that nerve dissection is advisable.

3. A tight and efficient closure in the opening of the canal in three layers is essential. Continuous leakage of spinal fluid is very badly borne by young children and in only one case in this series where leakage occurred for a period of more than twenty-four hours has recovery followed. In one case, however, there was persistent leakage for a period of nearly a week which was finally checked by a continuous silk suture which was kept in place until repair was advanced.

The after-treatment offers nothing of interest except that the dressings should be watched with great care and done as infrequently as possible, although it is rarely safe to leave them longer than two days at a time. The nursing of these cases is of the utmost importance and nowhere does experience in the nursing of infants count for more than in this class of operation. It has

been the writer's rule for a number of years to operate in private practice only when the child could be under the care of a graduate of the Infants Hospital or a nurse from the Children's Hospital Training School who had had experience with infants. This was departed from in two cases, both of which ended fatally and in one of them there was a suspicion that with a more skillful nurse the outcome might have been different.

The points in which the post-operative history of these cases is of interest are as follows: The temperature and pulse are both imperfect indications of the child's progress. If much shock is experienced at the time of operation, on the following day the temperature is likely to rise to a point between 102 and 105 degrees and this is of comparatively little significance, several recoveries having occurred after an alarmingly high temperature and one at least where the temperature reached 105 degrees on the second day. The pulse in the same way may rise to an alarming frequency and yet the patient be in fairly satisfactory condition. The most trustworthy indication of the infant's progress is to be obtained from the manner in which it takes his food. To nurse satisfactorily and to digest food are the best of indications in the presence of which pulse and temperature may be largely disregarded. Unwillingness to nurse, vomiting, and intestinal indigestion are unfavorable symptoms. In only two cases of the present series did a child die who had taken its food well within twenty-four hours of the fatal issue. Two cases nursed vigorously and digested their food well until shortly before death. For this reason it is advisable always to have the child under observation for at least twenty-four hours before operation if possible in order to be sure that the conditions as to digestion are satisfactory, and it is a most unwise proceeding to change the child from the breast to the bottle and to operate until the effect of this has been observed. Unfavorable symptoms are twitching of the face, eyelids, or hands, and convulsions. When these are present chloral and bromide have been given and in some cases the ventricles of the brain have been tapped where there was evidence of increased pressure, but from the latter proceeding no favorable result can be reported.

STATISTICS.—In the twenty-four cases to be reported nine operations were performed at the Infants Hospital, seven at the Children's Hospital and eight at the patients' homes and at private hospitals. Of the twenty-four cases, nine died within three weeks of operation, suggesting that the operation itself was the cause of death, making a mortality percent of $37\frac{1}{2}$ percent. The value that these figures have is derived chiefly, as has been said, from their agreement with other groups of cases. This mortality percent, however, is hardly representative because all cases from the beginning are included, many of which the writer would now recognize to be perfectly hopeless and the figure does not represent what the result would be in properly selected cases. Of eleven cases done in private practice only two died as a result of operation which is perhaps more nearly representative of what the result would be in carefully selected cases, although in this set the percentage of mortality is probably unduly low, and will undoubtedly become higher when more operations are added to this class.

Leaving aside the smaller reported series of cases, the carefully recorded larger groups are as follows: Bayer,² Prague clinic, 17 cases, 9 died; Bockenheimer,³ Berlin clinic, 20 cases, 7 died; Sachtleben,⁴ Breslau clinic, 18 cases, 6 died; Mayo Robson,⁵ 20 cases, 5 died; Hildebrand,⁶ 13 cases, 3 died. In all 88 cases with 30 deaths from operation giving 34 percent mortality due to operation. The lowest mortality percent is that of Hildebrand, 23 percent. In a paper by Nichol⁷ on spina bifida there is a statement that he had operated upon 32 cases with seven deaths but no detail and no analysis of the cases are given. There exists in Swedish literature⁸ a report of 229 cases operated on of which 82 died, 35.8 percent. Unfortunately the sources of this report are not available. That loosely reported cases cannot be depended upon as to figures is shown by the figures of Morton⁹ who reported 83 percent of recoveries from the injection of an irritant fluid composed of glycerine, iodine, and iodide of potash, a procedure which today has fallen largely into disuse. Taking together the figures from the most reliable sources we may conclude that, taking all cases together, the mortality from

operation is between 30 and 40 percent and that in selected groups of cases it should be in the neighborhood of 20 percent.

But this is only one-half of the story, for there is a mortality subsequent to operation which must be taken carefully into account in advising for or against operation. In the present series of cases it was disturbing from time to time to learn in the years following operation that the children operated upon, in some instances had died of hydrocephalus, of convulsions, of affections apparently intestinal, or of intercurrent affections. Until a search of the literature was taken up this was attributed by the writer to individual bad luck, but the experience of all operators has been the same; namely, that in the three years following operation a moderately large number of cases which had apparently recovered die from the affections mentioned. The Breslau operator sets this secondary mortality at 29 percent, the original mortality having been 33 percent from operation, and places the percentage of ultimate success at about 39 percent. Bayer combining his own cases with those of Hildebrand and Bockenheimer sets the final percentage of success at 18 but this is evidently too low, as Hildebrand found in ten cases which had recovered from operation that eight were alive from two months to twelve years after operation. In the present series of cases it is not possible to give the ultimate percentage of success, as the cases came from a wide area and covered many years. There were, however, a number of deaths from what may be called secondary mortality.

It would seem to be a conservative statement as to the results of operation in suitable cases in the hands of a surgeon used to the operation, that the mortality following operation would be about 25 percent or less, that the mortality in the next three years would be at least 25 percent from intercurrent affections, and that the percentage of cases that would ultimately recover would be somewhat less than one-half. That a complete and satisfactory recovery with a firm scar and no resultant disability occurs in a certain number of cases is demonstrated in this series as well as in those of other operators, no mental or physical defect being necessarily associated with the deformity.

Contrasted with these figures is the apparent hopelessness of the outlook when no operation is undertaken, when apparently nearly all of the cases die. Occasionally spontaneous rupture and recovery occur¹⁰ and rarely one sees a patient who has reached adult life with the tumor still in existence, but very few of the cases survive without operation. The London Clinical Society reported 649 cases, 612 of which died in the first year, and the experience of nearly all writers is to the same effect that recovery without operation is extremely unusual, for which reason the question of early operation becomes one of importance.

The contraindications to operation are generally accepted to be as follows:

1. Hydrocephalus. Any degree of bulging of the anterior fontanelle, or an unusually large head should be a positive contraindication to operation. Cases in which no signs of hydrocephalus can be determined will at time develop it after operation and it is a most distressing experience to watch a head gradually enlarge after operation until the fatal termination comes from some intercurrent disease.

2. The existence of other deformities of severe grade must be accepted in general as a contraindication to operation although they do not apparently affect the prognosis in the individual case.

3. Paralysis or the evidence of the involvement of large nerves in the sac is in general a contraindication to operation. There is little or no prospect for the relief of the paralysis from the operation, and it is a most important practical matter before operating upon any case to determine whether or not paralysis is present. In one of the writer's earlier cases a paralysis which probably existed was noticed after operation but in the absence of a definite examination to show that it did exist it was impossible to say that it was not the result of operation. With this exception in the writer's experience no paralysis has followed the operation although a few cases of this sort have been reported by other operators.

4. In the writer's opinion, the existence of a very large tumor, especially one connected with the spine by a large opening, should make one careful about operating. It is not a positive

contraindication to operation such as hydrocephalus, but the outcome is less likely to be favorable in such cases and they should be approached with care.

CLASSIFICATION.—The division of these tumors into their different varieties has not been made in the present series of cases but is insisted upon at considerable length by certain writers. The diagnostic signs given, however, are rather vague and complicated and the results of analysis of groups of cases of spina bifida into its different varieties are not encouraging, the following figures having been obtained as to the proportion of meningoceles.

Realli, 165 cases, 87.8 percent meningocele.

London Committee, 27 percent meningocele.

Taruffi, 187 cases, 13 percent meningocele.

v. Recklinghausen, 32 cases, no meningocele.

Later observers, Hewett, Muscatello, Bayer, Wertling, Bockenheimer, 0 to 22 percent meningocele.

Among the names given to the different divisions are the following: Myelocele, meningocele, myelocystocele, syringomyelocele, meningomyelocele, hydromyelia, myelocystomeningocele.

LOCATION.—In the present series of cases the tumor was most often found in the lumbar region, some being at the sacro-lumbar junction and some at the dorso-lumbar. There were some pure dorsal cases and two cervical cases. Of the latter one died and one recovered after operation. It would not seem as if the location of the tumor were a matter of great importance in formulating the prognosis. It is generally assumed that the cases in the lower part of the spine are more favorable than those in the upper part, but the operation in the sacral region is more difficult than elsewhere and the danger of staining and infection of the wound greater.

TIME OF OPERATION.—The earliest case in the present series operated upon was five hours after birth where the tumor had been ruptured at birth and immediate operation was necessary, and the child recovered. The next earliest case was done forty-eight hours after birth for the same reason and the child also recovered. Counting these cases, there were eleven operated on before the end of the second week with six deaths, a ratio of

mortality but little higher than the cases in general. The oldest case operated on was four months old. In a series of cases reported by the Swedish surgeons already alluded to⁸ the total mortality was 35.8 percent and in 34 cases operated on in the first week there was 41.1 percent mortality. It would seem, therefore, as if operation during the first few days of life was not a contraindication, but on general principles it would seem wiser not to operate so early unless it were necessary, the time of election perhaps being from two to three weeks after birth. The objection to waiting until the children are several years old as advocated by Moore¹¹ is that so large a proportion die in the first year if not operated on.

The indications for very early operation would be rupture of the sac or the presence of a sac so thin that rupture would seem to be inevitable. It is desirable that spontaneous rupture of the sac should not occur because infection is thus more likely to take place, and the operation on the whole is more difficult in a collapsed sac.

The points that it is desired to emphasize are that the operation by extirpation of the sac in spina bifida in the reported group of cases is followed by death in about one-third of the cases, that in properly selected cases in the hands of a surgeon used to the operation the mortality would be probably somewhat smaller, that there is a secondary mortality probably at least as great as the operative mortality, that ultimate recovery is to be expected in something less than one-half of properly selected cases, and that contrasted with the hopelessness of the outlook when no operation is done it would seem justifiable to advise operation in properly selected cases.

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