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ORIGINAL ARTICLES.

THE SURGICAL TREATMENT OF SUPPURATIVE PLEURITIS IN CHILDREN.

*Read in the Section on Surgery and Anatomy, at the Thirty-
Eighth Annual Meeting of the American Medical
Association, June, 1887.*

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In the very brief paper which I shall present, it is not my purpose to discuss the history of this disease, its etiology, its pathology, its progress or its general treatment. I propose simply to confine my remarks to the comparative merits of the operation of removing the pus by the old method of the trocar and drainage tube, with the more modern one of resecting or excising a portion of one or more ribs, restricting this comparison of the two surgical procedures, to the cases occurring in children.

It is known that as far back as the time of Hippocrates, the operation for the removal of pleuritic effusion, whether of pus, serum or blood, was practiced by the ancients, many crude and imperfect instruments being employed for this purpose, and circumstantial details of all the minutiae necessary at each stage of the operation laid down by Hippocrates himself. Not until 1665, however, we are told, was the ordinary trocar introduced and the operation of draining off the contents of the pleural sac by this means resorted to.

It was demonstrated that the supposed danger of introducing atmospheric air into the pleural cavity was and still is, greatly exaggerated, and the consequent employment of the trocar for this operation became more general. Scultetus, perhaps the most ingenious and skilful surgeon of his day, invented several instruments for this purpose constructed upon the principle of the trocar, but so arranged as to prevent the admission of air into the pleural cavity. He also was the first, so far as I have been able to learn, to use a drainage tube. It is not necessary, however, in tracing the history of this instrument in this connection, that I should follow its varying popularity, its triumphs and its defeats through a period of two or more hundred years; we will leave the discussion by its advocates and its opponents, preceding the present half century, and endeavor to present a brief outline of its use during this latter period. The late Professor Gross, in the second volume of his "Surgery," after giving in detail minute directions how the operation of tapping

the chest empyema should be done, using of course, the trocar, says that of 820 recorded cases but one death occurred by hæmorrhage in this operation; of 498 cases collected by Gunther in 1861, 302 were cured, 149 died, sixteen were improved, nineteen recovered with fistulous openings, and of twelve the result was unknown. Of 132 cases reported by Dr. Brady, 79 were cured. In a number of those which ended fatally irremediable ravages of the disease had occurred before the operation was done and others died of phthisis. Dr. Blake, of Boston, reported in 1879, nineteen cases operated on by incision as a means of introducing the drainage tube with fifteen recoveries. It is very much to be regretted that these cases have not been classified according to age, as the omission deprives us of the opportunity to compare the relative mortality between the adult and the child. In view, however, of the advanced and chronic condition of the disease so much more frequently met with in the adult with its accompanying results of extensive bands of adhesion, fibrous deposits and inspissated pus, it is fair to presume that the mortality was largely due to the fact that a majority of those operated upon were adults. If, however, with the acknowledged unfavorable conditions found in adult cases, such gratifying results could be obtained by the trocar alone or only partial drainage, how much greater success would have been achieved had these operations been confined alone to children, and if we add the still greater advantage of having used the drainage tube in each case, the result would undoubtedly have been more conclusively successful. Before further discussing the advantages of using the trocar and drainage tube over the operation of removing portions of ribs in children, we will refer to the recorded statistics of each of these procedures, embracing: *First*, a tabular statement prepared by Dr. Godlee of thirty-four cases of empyema in children treated at the North-Eastern Hospital, London, including four cases treated at the Brompton Hospital; *Second*, nineteen cases from the reports of St. Thomas' Hospital of children under 3 years of age.

Gross somewhere speaks of having operated 150 times by tapping followed by successful results in a majority of the cases, and Dr. Henry I. Bowditch in a letter recently addressed to me speaks of his last operation by tapping as the 399th. In neither of the latter reports have I been able to find that any tabulated statement was ever prepared, giving age, date of operation, specific conditions of each case and results in each.

TABLE OF CASES REPORTED BY DR. GODLEE.

NO.	AGE.	DURATION.	TREATMENT.	RESULT.	NO.
1	1 year.	3 months.	Aspirated January 9, 1883, 1 pint; Jan. 23, 6 oz.; Jan. 30, 4 oz. Opened Feb. 10, behind, rib removed.	Death. Empyema on opposite side.	1
2	1 yr. 3 mos.	1 month.	Aspirated July 11, 1884, opened July 26, part of 8th rib removed behind.	Cured in six weeks.	2
4	2 years.	6 weeks.	Opened August 1, 1885, rib removed behind; tube out August 13.	Cured in four weeks.	4
5	2 yrs. 4 mos.	9 weeks.	Aspirated July 4, 1885, opened through abscess July 7, tube removed July 15. Part of 7th rib removed; tube put back Aug. 7; finally removed Aug. 15.	Cured in nine weeks.	5
6	2 yrs. 5 mos.	14 days.	Aspirated Aug. 14, 1883; opened, rib removed behind Aug. 17, tube removed Sept. 1.	Cured in five weeks.	6
7	2 yrs. 6 mos.	8 months.	Aspirated Feb. 9, 1885, opened, rib removed behind, Feb. 28, tube replaced twice, counter-opening June 17.	Left in September, not quite healed.	7
8	3 years.	2 months.	Aspirated Aug. 20, 1883, opened August 24; rib removed behind; tube removed Oct. 2.	Practically cured in eight weeks.	8
9	3 years.		Aspiration failed; opened Nov. 14, 1883; rib removed behind.	Cured in ten weeks.	9
11	3 years.	5 months.	Aspirated Dec. 3, 1883, 2 oz., Dec. 4 1 oz.; opened, rib removed behind Dec. 7.	Practically cured in seven weeks.	11
13	4 years.		Aspirated Oct. 31, 1884, 29 oz., sweet; Dec. 8, expectorated, 2 oz., fetid; opened Jan. 25, 1885; rib removed behind, pus fetid.	Cured in eight weeks.	13
15	4 years.	2 months.	Aspirated Aug. 9, 1885. Opened Aug. 5, rib removed behind. Tube removed Aug. 26, put back Aug. 31, finally removed Sept. 16.	Practically cured in five weeks. Tube removed too soon.	15
3	1 yr. 10 mos.	3 months.	Opened Nov. 23, 1881, behind; tube out Dec. 13.	Cured in five weeks.	3
10	3 years.	6 months.	Aspirated Nov. 25, 1884, 5 oz. very thick pus.	Cured by one aspiration.	10
12	3 yrs. 4 mos.	3 months.	Aspirated May 12, 1885, 4 oz.	Cured by one aspiration.	12
14	4 years.	3 months.	Aspirated April 28, 1884, one syringe.	Cured by one aspiration.	14
16	5 years.		Aspirated April 7, 1882, 10 oz., April 9, 7 oz. Opened April 10. Tube re-inserted Sept. 9.	Practically cured in six months.	16
17	5 years.		Aspirated July 24, 1883, 4 oz., July 26, 11 oz. Opened Aug. 12, rib removed behind, tube left out Aug. 29.	Cured in four weeks.	17
18	5 years.	1 month.	Expectorated two months after commencement of illness.	Cured.	18
19	5 years.	5 months.	Part of 7th rib removed and tube put in Feb. 17, 1883, left out March 27.	Cured in six weeks.	19
20	5 yrs. 6 mos.	2 weeks.	Aspirated April 13, opened, 10, rib removed behind.	Cured in eight weeks.	20
21	5 yrs. 6 mos.	10 days.	Aspirated June 16, 1882, 26 oz. Opened July 1, 7, interspace, July 7, rib removed, tube left out Sept. 2.	Cured in fourteen weeks.	21
22	5 yrs. 6 mos.	4 days (?)	Aspirated May 12, 1884, opened 27, rib removed July 13, second opening further back.	General health good, but sinus remains Sept., 1885.	22
23	6 years.	5 weeks.	Aspirated Jan. 29, 1885; subcutaneous rupture near nipple; February 7, opened through abscess 6th interspace, no rib.	Cured in eight weeks. Trouble with tube.	23
24	6 years.	4 months.	Aspirated Jan. 10, 1885, opened, rib removed behind, 26th.	Small cavity remaining three months.	24
25	6 years.	4 months.	Aspirated Nov. 18, 1884.	Cured by one aspiration.	25
26	6 years.	6 weeks.	Aspirated July 7, 1885, opened, rib removed behind 17th, tube rem'd 29th.	Cured in three weeks.	26
27	7 years.	3 weeks.	Aspirated Aug. 24, 1883; 27th, 4 oz.; Sept. 1, 9 oz. Opened, rib rem'd behind Sept. 8, tube left out 20th.	Cured in three weeks.	27
28	8 years.		Aspirated April 10, 1882, opened 21, 7th interspace, no rib.	Cured in four weeks.	28
29	9 years.	9 days.	Aspirated May 2, 1882, 3 oz., 5th 22 oz., 19th 20 oz. Opened 23d, no rib. Tube removed July 19.	Cured in nine weeks.	29
30	10 years.	12 months.	Opened through abscess in 7th interspace, no rib, March 31, 1883. Pus vomited during operation.	Practically healed in seven weeks.	30
31	5 yrs. 6 mos.	5 months.	Sept. 6, 1883, piece of 6th rib outside nipple removed; healed; reopened Nov. 30.	Never completely healed. Died afterwards of bronchitis. (A very delicate child.)	31
32	6 yrs. 6 mos.	3 months.	June 18, 1885, incision.	Healed in three months.	32
33	7 years.	1 month.	Aug. 27, part of 7th rib removed.	Healed on Sept. 22 (under five weeks).	33
34	10 years.	5 months.	Dec., 1883, openings dilated; Feb., 1884, parts of 5th, 6th, 7th and 8th ribs removed; July 11, several other pieces of rib removed; Nov. 20, openings into 1st intercostal space.	Much improved. All closed but a minute cavity, into which a straight celluloid tube 2½ in. long was inserted.	34

The above statistical table, examined in detail, shows that the ages of those operated upon ranged from 1 year and 3 months to 10 years and 5 months: Three under 2 years, four under 3 years, five under 4 years, three under 5 years, eight under 6 years, five under 7 years, two under 8 years, one under 9 years, one under 10 years, and two under 11 years. Of the first group one was aspirated three times, no drainage tube used. Rib resected at the end of one month; died. One aspirated once, no drainage tube; rib resected fifteen days later, recovered in five weeks.

Of the second group one was resected and cured in four weeks; three were first aspirated, no drainage tube, subsequently resected and recovered. Of the third group, three were aspirated, no drainage tube use, finally portion of rib removed, followed by recoveries; two were cured by one aspiration. Group four shows that all three were aspirated, followed in two of them by excision of rib, with recovery in all three cases. Of the seven cases included in the fifth group, five were first aspirated, no drainage used, followed by removal of ribs in each case, resulting in cures. The remaining two were subjected to resection of ribs without being previously aspirated, also resulted favorably. The sixth group included four aspirations, no drainage tube in either case, subsequent resection of ribs with three cures and one partial success. Group seven embraces but two cases, one aspirated before the resection was performed, and the other rib excised at first operation; both cured. The eighth and ninth groups including one case each; both aspirated at first, but subsequently opened by incision and drainage tubes inserted; one recovered in four weeks and the other in nine weeks. The tenth group numbers but two cases, one cured by pleurotomy and drainage tube, the other greatly benefited by extensive resection of parts of the fifth, sixth, seventh, and eighth ribs, but not reported as cured. It thus appears of the thirty-one cases reported as cured in this table, twenty-five were subjected to the antecedent operation of aspiration, and six to primary resections: Four of the twenty-five were cured by one aspiration alone, the remaining twenty-one were all subsequently treated by removal of one or more ribs. It will be observed that in all the cases in which resection was practiced, the drainage tube was inserted and retained, as a rule, until the cure had been completed. Had such a plan been adopted in the first instance, when the operation of tapping was performed, it is more than probable that not one of the twenty-one children so treated would have been subjected to so grave and hazardous an operation as excision of the ribs. The four cases of recovery by one aspiration alone goes to demonstrate the conservative capacity of nature when left in a large degree, to her own resources, as well as the energetic and active process of absorption going on in childhood.

An analysis of this table shows that all but one of these cases were subjected to the operation of tapping before excision of the rib was resorted to. In one case four antecedent tapplings, two cases of

three tapplings, two cases of two tapplings, and nine having been tapped but once. As it was found

THE RESULT OF EXCISION OF A PORTION OF RIB IN FIFTEEN CASES OF EMPYEMA, FROM ST. THOMAS' HOSPITAL REPORTS, LONDON.

No.	Age.	Tapping before Operat'n.	Side.	Tube used before Operat'n.	Chronic Fistula.	Ab. Callus.	Result.
1	5½ male.	4	Left.	None.	None.	None.	Cured.
2	5	None.	"	"	Yes.	"	No benefit.
3	5	1	"	"	None.	"	Cured.
4	13	1	Right.	"	"	"	"
5	31	1	"	"	Yes.	"	Working (CPk)
6	13	3	Left.	"	None.	"	Cured.
7	44	2	"	"	"	"	"
8	58	1	Right.	"	Yes.	"	Died.
9	19	1	"	"	None.	"	"
10	24	3	"	"	Yes.	"	Some benefit.
11	20	2	"	"	None.	"	Cured.
12	23	1	Left.	"	"	"	"
13	25	1	"	"	"	"	"
14	34	1	"	"	"	"	Died.
15	23 Female	1	Right.	"	"	"	Cured.

Remarks.—Drainage-tube was used in all cases after excision of rib. The average stay in hospital was 185 days.

necessary to perform the operation of resection of one or more ribs subsequently, it is fair to suppose that the prior operation of tapping had failed to effect a cure. Of the whole number operated on 9 were cured, 3 died and 2 only benefitted. It will be observed that in all these 15 cases in which a portion of the rib was removed, drainage tubes were introduced, but in not one case in which tapping alone was practiced did the operator introduce a drainage tube; had this been done (which can always be easily effected by the use of a large trocar or enlarging with a bistoury, the opening made by the trocar), and the pleural cavity kept drained of its contents, the same favorable results would have followed and the more extensive and dangerous operation of resection been found unnecessary. In children it is rarely we find more than a single cyst, and when diagnosed in the early stages, more frequently contain serum than pus, hence the facility with which cures may be effected in such cases, sometimes by one or two aspirations only, but more surely when the drainage tube is used, to avoid a reaccumulation of the fluid and allow a speedy expansion of the lung. This, however, is not always the case; we sometimes meet with instances of pure purulent pleurisies in children where there has been no antecedent accumulation of serum or exudation of lymph upon the serous lining of the cavity, pus has been secreted from the very commencement of the attack and the cavity most usually in such cases found to be well filled. It has not been found that these conditions are associated with tubercular contaminations, but in those who are free from such hereditary tendency. In advocating the superiority of the trocar with drainage tube for the removal of these accumulations over the operation of resection of ribs, the following considerations present themselves to my mind as furnishing satisfactory reasons for such a preference.

First, as above stated in children the fluid is most frequently found occupying a single sac or cyst being

of recent date. The conditions found to exist in chronic cases, such as fibrous bands, pouches, sacs, forming numerous isolated cavities, inspissated pus, thickened pleuræ, etc., are absent. The compressed lung tissue has not undergone any parenchymatous changes affecting its natural elasticity, the mechanical pressure of the fluid being removed it readily resumes its normal capacity. The surfaces of the pleural cavity not having experienced those pathological changes usually found in chronic pyogenic membranes and the functions of absorption being more active in children, the partial removal of the contents of the sac by aspiration alone may give an increased impetus to that function and establish a cure by absorption.

It may be that the stimulus of atmospheric air plays some part as a conservative agent in adding energy to this process. Godlee, who it seems resorted to the operation of excision, in all of his cases, as reported in the table which I have quoted above, acknowledges in one of his papers that the operation of tapping children is often successful and recommends that in young subjects it should always be done at first and two or more tapplings resorted to if necessary, before the graver operation of excision of rib be performed. He, however, fails to advise what in my judgment constitutes almost a *sine qua non* to early success in all these cases of tapping; the additional use of drainage tube. The objection which has been urged against this operation in children, namely, that the space between the ribs does not admit of using a trocar of sufficient calibre to accommodate a large sized tube and that it is almost impossible to keep the sinus or opening patulous for any length of time presents, to my mind, no significance, since the experience of those who practiced this operation through a long series of years, furnishes a positive contradiction to this criticism.

Every surgeon knows that such a difficulty can always be overcome by enlarging the opening with a common bistoury. In support of these views I here introduce the letter already referred to, of Dr. Henry I. Bowditch, of Boston, who has perhaps performed the operation of tapping the chest oftener than any other man now living. He says:

"For thirty-seven years I have been using the exploring trocar and suction pump in cases of pleuritic affection. Sometimes repeatedly in the same person, and generally with success if the patient has been seen early enough. Years since I began in several cases to make permanent openings by means of a large trocar and canula, the latter being left in the opening. I have injected, at times, simple warm water (would it not be well under modern antiseptic ideas to use almost hot water?), I have injected repeated syringefuls *until the water was returned apparently free of pus.*

"Generally, however, I have made no injection, if the patient with the free discharge has been improving.

"Exsection of a rib I have never deemed necessary in childhood, nor in adults when the patient has been seen early enough to be able to try the above operations, one or both, without success. I have advised

it with advantage, in some cases, of adults. Like everything else that is good in this world, it has been at times of late used most inappropriately and extravagantly as in one of my own cases, while the patient was traveling in Europe and with death as the result. Nevertheless, I believe that used cautiously it will be of great advantage in certain chronic cases.

"As I have never seen a case in childhood where I have felt called on to advise exsection, so I feel indisposed to advise it now, if any other course promises success.

"I am sorry that I can not give you any more detailed statistics. In a general way I will say that I made my last operation (399th), on my 256th patient, Aug. 25, 1886."

It will be observed that this experienced and eminent surgeon fully endorses the views which I have endeavored to present in this paper. He says exsection of a rib I have never deemed necessary in children. With a record of 390 operations, a large proportion of whom were children, his judgment on this point is not only entitled to our respect but should be regarded as conclusive. Excision of a portion of one or more ribs for empyema as a substitute for, or supplementary to, the operation of tapping is a surgical procedure of comparatively modern date, although it has been claimed that it was first suggested, if not performed, by Celsus. In this country I believe that Dr. Warren Stone, of New Orleans, was the first to do the operation. Estlander, of Helsingfors, seems to have directed more general attention to this practice and extolled its peculiar merits. So far as I have been able to learn by reference to the recorded views of many distinguished surgeons of modern times, no distinction is made by them who advocate the operation of resection, between adults and children, perhaps, more frequently performed in cases of the latter than the former. So far indeed as the statistics of hospital practice within the last decade show, the rule has been to operate by resection in all cases of children.

As I have above stated in discussing the superior merits of tapping the conditions most usually met with in young children differ so materially from those encountered in the chronic cases of the pleuritis of adults, that I think age should be regarded as a factor of primary importance in determining the exact diagnosis as well as selecting the particular mode of surgical interference. When we consider the fact that the bony fabric of the chest in the child is still in a condition of progressive physical development, the rapid and excessive deposit of callus following the solution of continuity of a rib, protruding into the cavity of the chest and irritating the lung, the inevitable deformity and loss of symmetry in expansion of the two sides of the thorax, which is apt to follow the removal of one or more ribs, the growing condition of the child which necessarily adapts itself to the physical results of the traumatic interference, establishing often a permanent deformity, associated at times with more or less spondylitis, and a greatly restricted respiratory capacity of the chest; the

pouch of periosteum from which the excised piece of rib has been dissected; the protracted healing and long continued dressing of the open wound, augmenting the chances of septicæmia and exhausting the vital energies and recuperative resources of the little sufferer. We should hesitate before resorting to so grave a surgical procedure when a more simple and conservative one can be safely and successfully practiced.

In presenting the above criticism upon the operation of resection or removal of one or more ribs for the cure of empyema it will be remembered that I have reference to the operation upon young children exclusively, having in view simply a desire to call attention to the importance of discriminating carefully in the surgical treatment of these cases between adults and children.

Jacobi says: "Excision of the ribs should never be practiced in children."

J. Lewis Smith says: "That he never could conscientiously recommend excision in any case in his practice, hospital or private."

T. Clifford Alburt says: "Resection of a portion of two or more ribs may be necessary in some cases, but such cases will become very rare as diagnosis and early operative relief are more generally understood." If I deemed it necessary I might add the testimony in support of my views upon this subject, of many other experienced and skilful surgeons. The following brief notice and accompanying photograph of a case upon which I operated some three years ago will serve to illustrate the simple but effectual procedure advocated in such cases.

This youth was sent to me from the country supposed to be far advanced in phthisis. Had suffered for six months with symptoms of tubercular consumption including expectoration of large quantities of pus. A careful physical examination revealed the presence of empyema of right chest, pleural cavity well filled with pus, and lung compressed against spinal column. I decided to tap him at once with a medium sized trocar, which was done through the sixth intercostal space, and about 32 oz. of pus drawn off. The cavity was not washed out nor was a drainage tube inserted. Great relief was afforded the boy and the cough almost entirely suspended.

In three weeks the pleural sac had refilled entirely with pus, all of the distressing symptoms returned and the patient and friends despondent. I now determined to repeat the operation of tapping with a large trocar, and introduced a soft rubber tube. At this operation nearly the same amount of pus was drawn off and after the cavity had been washed out with tepid water the tube was inserted and kept in its place by the device represented in the picture. A large piece of soft sponge moistened with carbolic water was placed so as to allow the end of the tube to rest on it and confined by a bandage, no antiseptics used.

Each succeeding day the cavity was washed out with tepid water, at first nearly one quart being used. In three weeks the cavity had so diminished by the expansion of the lung that but 1 oz. of fluid

could be thrown in, and at the expiration of four weeks the tube was removed and the sinus allowed to heal. The patient continued to grow fat and strong and is now perfectly well. In this connection I may refer to the mooted question of using injec-

tions after drawing off the contents of the cavity. Many surgeons object to their use while others employ them. Dr. Cayly, of England, reports many cases of sudden death resulting from injections of simple water, solution of iodine and of carbolic acid. In all of which death occurred after repeated injections had been used with apparent impunity. As no explanation of the cause of death in such instances has been offered, and as the practice of using tepid water has been so generally and safely employed I can see no rational grounds for entertaining such apprehensions.

UTERINE SUBINVOLUTION AND AREOLAR HYPERPLASIA.

Read in the Section on Obstetrics and Diseases of Women, at the Thirty-Eighth Annual Meeting of the American Medical Association, June, 1887.

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Physiologically considered, the uterus is more subject to variations in size than any other organ of the human body. "Its weight, but little more than one ounce in the virgin state, increases during pregnancy to upwards of two pounds. After labor, in two days it falls to a pound and a half; during the first week to one pound. The cell elements are consumed, compression of nutrient blood-vessels cuts off fresh supplies from the oxidized protoplasm, and in from six to eight weeks the uterus is reduced to almost its normal proportions." If this tearing down and carrying away, by nature's forces, that structure which enveloped the child and nourished it during the period of intra-uterine existence, stops short of completion, we have the condition known as subinvolution or arrested retrograde evolution.