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CLOSED DRAINAGE IN THE TREATMENT OF EMPYEMA

WITH A REPORT OF FORTY-TWO CASES IN INFANCY AND CHILDHOOD*

BY

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Hippocrates taught that in cases of empyema the operation to drain away the purulent effusion should not be performed before the fifteenth day after the onset of the illness. He also advocated irrigation of the cavity. His teachings therefore foreshadowed two principles in the modern treatment of this disease.

PRINCIPLES OF MODERN TREATMENT

Delay before Operating.—Empyema is not to be regarded as a surgical emergency requiring operation as soon as it is diagnosed. The necessity of waiting until the adhesions between the lung and the chest wall are sufficiently firm to prevent the lung from pulling away from the chest when the thorax is opened is well recognized. It is also advisable in most cases to wait until the pneumonic process has subsided before continuous drainage of the empyema is undertaken, the pus being removed by repeated aspiration until such time as the pneumonia has resolved. All the cases here reported have been aspirated at least once—depending on the nature of the condition. In cases of empyema due to the streptococcus, effusions into the pleural cavity are prone to occur at an early date, and firm adhesions between the visceral and parietal pleurae do not take place as readily as when the infecting organism is the pneumococcus. Where the empyema is caused by the streptococcus, therefore, aspiration is persisted in longer than where it is due to the pneumococcus. In the latter case we feel that adhesions between the lung and the chest wall are sufficiently firm to prevent collapse of the lung after thick pus has been present for one week; while in the case of the streptococcus we consider that we must wait from two to three weeks for the above desired result. Here it may be well to point out that in aspirating pus from the pleural cavity, the utmost care should be taken to prevent air from entering the thorax. It is always very disappointing for a surgeon to find that an exploratory puncture has been performed, and that

air has been allowed to enter the chest, with additional lung collapse and spread of infection.

Irrigation.—The second principle employed by Hippocrates was that of irrigation. While he washed out the cavity with wine and oil "to cleanse the surface of the lung," we use Dakin's solution to overcome the infection, to liquefy the masses of fibrin so that they will pass out through the catheter, and to soften the exudate which covers the surface of the lung and impedes its expansion.

Application of Negative Pressure.—The third principle—which Hippocrates did not employ—is the application of negative pressure to assist in expanding the lung and thus obliterate the cavity. Forty years ago Beulau inserted a catheter through a trocar into the thorax, drained off the fluid, and applied negative pressure drainage. Since that time the closed method of drainage in empyema has had some advocates and many adverse critics. Notwithstanding the advantages claimed by those who used the closed method, it has been slow in coming into general use. After a personal experience with the closed drainage combined with irrigation of the cavity with Dakin's solution in more than fifty cases of empyema, I have found that this way of treating the condition is so much better that I have abandoned the open method. I therefore take this opportunity of focusing attention on this subject, in the hope that those who have not hitherto given this method a trial will do so.

APPARATUS

I wish also to call attention to a very simple apparatus which I have employed for this form of treatment, as

Illustrating closed drainage of empyema.—To irrigate the cavity the rubber tube connecting the Y glass connexion with bottle A is clamped, after which the clamp is removed from the tube connecting the Y with the container for Dakin's solution; when the abscess cavity is filled the solution is clamped off and the clamp between the Y connexion and bottle A removed, allowing the solution to drain off by suction into bottle A. To remove the solution accumulated in bottle A, clamp both rubber tubes leading from the glass connexions in the cork; the cork may then be withdrawn and the bottle emptied without disturbing the siphon.

I feel that one reason why more surgeons have not given the method a thorough trial is the complicated nature of the apparatus described from time to time for its

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application. This apparatus, for which nothing original is claimed, consists of three ordinary Winchester bottles with rubber stoppers pierced with two holes for glass rods, a flask for Dakin's solution, and some glass and rubber tubing (see figure), all of which may be obtained at any chemist's at small cost.

TECHNIQUE OF OPERATION

The operation is carried out under local anaesthesia. It can be performed quite readily in bed if the patient is too ill to be moved. In the case of infants and children a catheter size No. 16 or No. 18 (French) is inserted through a trocar between the ribs, and the trocar withdrawn. The opening around the catheter is then sealed by the application of successive layers of absorbent cotton saturated with collodion until a collar is built up around the tube, five inches in diameter, and about half an inch thick. This dressing is then fanned for half an hour before the patient leaves the table, when the collodion is sufficiently firm to allow of the child being moved without danger of disturbing the dressing. A clamp is left on the end of the catheter for four hours, when it is removed and the suction drainage connected. Irrigation of the cavity with Dakin's solution is begun the following morning. These irrigations are carried out every two hours during the day, and two or three times at night. The top of the fluid in the container for Dakin's solution is never allowed to be more than eighteen inches above the opening in the chest. To irrigate, the clamp is removed from the tube leading from the Dakin's flask and the solution allowed to run into the chest until it causes pain or stops running from equalization to pressure. This clamp is then replaced, and the clamp from the tube leading to the suction is removed, when the solution drains off into No. 1 bottle. If the catheter becomes plugged with fibrin, as sometimes occurs, it can usually be freed quite easily by disconnecting it from the drainage and injecting saline or Dakin's solution with a syringe.

The temperature usually goes down to normal in two or three days. The lung expands rapidly, and the amount of pus in the washings rapidly diminishes. After the washings have returned clear for five days, we consider that the cavity for practical purposes is sterilized, and if the lung has expanded satisfactorily and the general condition of the patient permits, the tube may be removed from the chest and dry dressing applied.

Though the majority of my cases have been concerned with children, I have also found this method equally satisfactory in adult empyema, and have treated two cases of subphrenic abscess, with results that were much superior to those obtained by the usual open method of treating that condition.

RESULTS

Forty-two cases of acute empyema in infancy and childhood were treated by this method. In twenty-two cases the infecting organism was the pneumococcus; in five cases the staphylococcus; in three cases the streptococcus. Six were reported "no growth," and in six cases no report could be found.

The following group shows the number of cases in each year of life.

Year	Number	Year	Number
1st	4	7th	3
2nd	7	8th	2
3rd	8	9th	3
4th	4	10th	2
5th	3	11th	1
6th	5		

The youngest child was aged 4 months, and the eldest 11 years. There were eleven cases among children in the first two years of life, and more than half the cases were

in children of 4 years of age and under. Of the children in the first year of life, one was aged 4 months; one 5 months; one 6 months; and one 11 months. All of them recovered.

The average number of days of drainage was 25.06. This includes all days in which there was drainage from the empyemic cavity.

There was one death, making a mortality of 2.38 for the series. This occurred in the case of a child, aged 14 months, who developed empyema following bronchopneumonia. The child's condition was extremely grave when first seen. Vomiting and diarrhoea were present, and persisted until death. The chest was first aspirated and then drained by the usual method. The condition, however, gradually grew worse, and death occurred a week after the institution of the closed drainage. The infecting organism was the pneumococcus. It was found on necropsy that the child had developed pneumonia in the other lung, and that acute pericarditis was also present.

There was one case of pleural shock. This occurred while irrigation of the cavity was being carried out by an inexperienced nurse, who allowed the Dakin's solution to continue to run into the thorax after the child began to scream with pain. Contrary to regulations, the container holding the Dakin's solution had been placed nearly three feet above the opening in the chest, instead of the required eighteen inches. The child gasped for breath, and rapidly became cyanosed, with weak and rapid pulse, and presented the appearance of impending dissolution. When an attempt was made to siphon off the Dakin's solution, it was discovered that the catheter was blocked. I happened to be in the hospital when the accident took place, and at once removed the tube from the chest and allowed the contents of the pleural cavity to escape. Some improvement took place at once. Suction was again applied, and the child went on to recovery, though its condition for some six to eight hours was extremely grave.

There were two cases of pocketing—one in a child aged 6 months, and the second in a child of 2½ years. In both cases the secondary collection of pus was discovered while the child was still in hospital, and was drained in the usual way. In the first case a period of ten days, and in the second case of thirty days, was required for additional draining.

Three cases developed cellulitis of the thoracic wall, which, though not serious, was troublesome, and prolonged the convalescence. All three cases followed aspiration.

There were two cases of bronchial fistula. In one case the fistula did not interfere with the application of negative pressure. In this case irrigations were discontinued, and the fistula closed in two days. In the other case it was found impossible to maintain negative pressure. A small amount of Dakin's solution was allowed to run into the cavity twice daily, with the tube in the most dependent position, and immediately siphoned off. It was found that this could be done without provoking spasms of coughing. In this latter case the fistula closed in six days. Irrigations were then begun and negative pressure applied in the usual way.

With the exception of the two cases of pocketing there were no cases requiring secondary operations.

ADVANTAGES OF CLOSED METHOD

The advantages of the closed method over the open method fall under two headings—namely, mortality and morbidity.

Mortality.—The mortality under the closed method is lowered—in this series of cases to 2.38 per cent. The greatest reduction in mortality takes place in infants.

This reduction in the death rate can be attributed to the following causes: (a) the use of general anaesthesia is avoided; (b) surgical trauma is lessened; (c) the danger of secondary infection is greatly reduced.

Morbidity.—The period of illness is shortened, the average number of days of drainage being 25.06 days, while the average by the open method is six weeks. In my early cases the tube was left in the chest an unnecessarily long period; had these early cases been treated in the same manner as the later ones the average number of days of drainage would have been considerably reduced. This shortening of the period of drainage can be accounted for, first, by the action of the Dakin's solution in overcoming the infection and by its power of softening the exudate covering the lung surface, and secondly, by the assistance of negative pressure in expanding the lung and obliterating the cavity.

Another advantage of the method by no means unimportant is the elimination of the usual painful daily dressing, as anyone who has had experience with the open method of treating this condition in children can testify.

INTRANASAL DACRYOCYSTOSTOMY FOR RELIEF OF LACRYMAL OBSTRUCTION

AN ANALYSIS OF 63 CASES*

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The not infrequent failure of conservative treatment and the disappointments following extirpation or curettage of the tear sac for the relief of lacrymal obstruction have induced surgeons from time to time to attempt various methods in an endeavour to re-establish permanent intranasal drainage of the lacrymal apparatus.

HISTORY

With this end in view, the tear drainage apparatus has been approached surgically in three directions: (1) externally through the skin, (2) transantrally, that is, through the maxillary antrum, and (3) intranasally.

In 1904 Toti¹ described his external operation of "dacryocystorrhinostomie" in which, by an external incision, a communication is made between the lacrymal sac and the nasal passage. I have no personal experience of this method, but the best results are said to be obtained with large tear sacs, while there is some risk of injuring the delicate canaliculi. Mr. E. D. D. Davis,² however, prefers Toti's external operation, even in the presence of a suppurating sac or an external fistula, and finds it mechanically an easier and surer method than West's operation. Ten cases so treated were all successful. V. Eicken adopted a transantral approach, but the difficulties of the operation and the anatomical fact that the sac cannot be drained without removing some of the floor of the orbit soon prejudiced this method.

The intranasal route was first adopted by Caldwell in 1893, when he opened and drained the tear duct intranasally after a preliminary resection of the anterior end of the inferior turbinate bone. Similar attempts were made by Killian, Passow, and Okunoff. Between 1908 and 1910 West operated in seven cases, but he approached the nasal duct above the inferior turbinate body. He soon realized, however, that the obstruction lay at the junction of the tear duct with its sac and not at its lower

nasal opening. Strazza in 1903 was the first to open the tear sac intranasally, but he did so by first exposing and opening the tear duct and tracing it upwards to the sac. To West³ of Berlin, and to Dr. R. D. Paterson of Cardiff, belongs the credit of being the first to approach the sac directly. The operation of intranasal drainage of the lacrymal sac (intranasal dacryocystostomy) is therefore frequently termed "West's operation." J. S. Fraser of Edinburgh, who has done much to perfect this operation and place it on a sound basis, first performed it in 1915, and has recently⁴ reported his results—seventy-five cures in eighty-nine West operations.

Between 1923 and 1929 I have, through the kindness of my colleagues on the staff of the Manchester Eye Hospital, performed seventy-nine West operations. The results, at least nine months after operation, have been traced in sixty-three cases. From a study of the records of these, an attempt has been made to obtain some information of the prospects of a permanent cure following intranasal dacryocystostomy, and also to ascertain the features that should guide us in making a selection of suitable cases.

TECHNIQUE

The success of the operation depends so much on its technique that, although the method has been so well described by West, Fraser, and others, a few details seem worth mentioning which from experience I have come to regard as important. Briefly stated, intranasal dacryocystostomy consists in the intranasal exposure and removal of the nasal wall of the tear sac, as it lies in the bony lacrymal groove, by removing the overlying nasal mucosa and bone. Anatomically, the lacrymal sac, in the majority of instances, is related intranasally to that region of the nose just in front of the anterior attachment and upper half of the anterior free border of the middle turbinate body.

Like Mr. Fraser I have abandoned local anaesthesia. The posterior margin of the frontal process of the superior maxilla, as it forms the anterior boundary of the lacrymal fossa, is occasionally too dense to remove comfortably with local anaesthesia alone.

About ten minutes before the induction of general anaesthesia the mucous membrane just in front of the anterior attachment and anterior border of the middle turbinate is injected with 1 per cent. novocain-adrenaline solution (2 to 3 minims of adrenaline to 1 drachm of 1 per cent. novocain), the nose having previously been well packed with the usual cocaine-adrenaline gauze. The local ischaemia thus produced is a distinct advantage, though in a few instances, in spite of this injection, troublesome haemorrhage has considerably increased the difficulties of the operation.

Anterior middle turbinectomy was performed in only nine cases. It should be avoided, unless absolutely necessary to gain access, as the persistent oozing of blood tends to obscure the field of operation. Anatomically it is rarely demanded, since Thorsch and others have demonstrated that in fully 65 per cent. of cases the middle turbinate body lies behind the lacrymal groove.

The nasal wall of the tear sac should be thoroughly exposed by a liberal removal of the overlying bone, otherwise granulations growing from the cut bony margins will, in course of time, coalesce and completely occlude the new ostium. I have found a long narrow and slightly curved chisel more effective and easier to manipulate than a gouge; in fact, I rarely use the latter, except, perhaps, to trim the margins. Having exposed the bone of the lacrymal fossa intranasally by the removal of a square-shaped piece of mucous membrane, I proceed to remove it in one piece. Three incisions with the chisel are made at the extreme anterior, upper, and lower boundaries of the exposed bone. They are joined anteriorly, while

* A paper read before the North of England Ophthalmological Society, October, 1930.