

abruptly elevated, with the result that the beak of the instrument is pried forward from the finger tip into the opening of the tube. If difficulty is experienced with

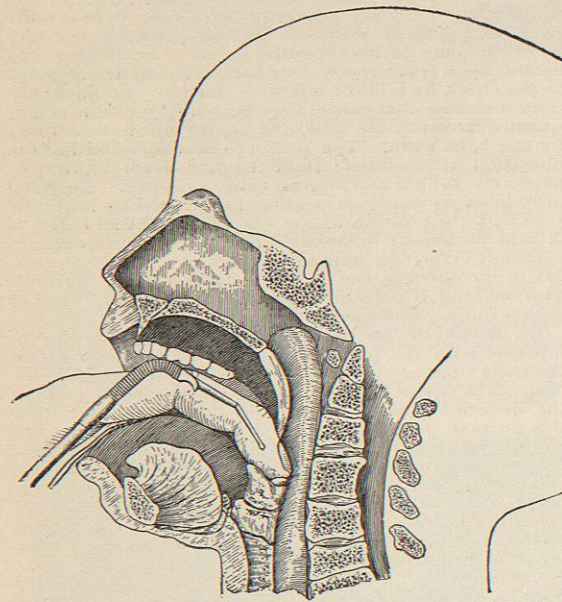


FIG. 2948.—The Left Forefinger Thrusting the Tube in Place and Holding it until the Obturator is Released and Removed from the Mouth.

this method of extraction, the tube may be removed by the same method employed in introducing it, *i.e.*, the extractor is passed along and under the index finger, which is holding back the epiglottis.

Care should be taken to regulate the degree of opening of the jaws of the extractor by means of the guard screw (Fig. 2942, *a*), in order to avoid laceration of the tissues by their wide separation, during ineffectual attempts to find the opening of the tube. The spring of the extractor should not be touched until the beak of the instrument is engaged in the tube. As in introducing the tube, no force is necessary.

Removal of the tube by "enucleation" has been practised to some extent. The short tubes of Bayeux already referred to are better adapted to this method, although the operation is possible with O'Dwyer's tubes. The child is held head downward, while pressure is made on the trachea just below the point of the tube. This operation, while it is not to be relied upon, especially with the O'Dwyer tubes, is certainly worthy of a trial in an emergency, as for instance when there is a sudden blocking of the tube which is not followed by expulsion. In cases also in which the tube has slipped below its proper position, it is perhaps better to try this method rather than risk pushing the tube farther down with the extractor.

*When to Extubate.*—With the use of antitoxin, the time during which a tube need be retained has been materially shortened and reintubation is much less frequently required. The retention of the tube is dependent on the general condition of the patient, the amount of toxæmia present, the condition of the pulse and temperature, the presence of membrane in the pharynx, and the age of the patient. Children under two years of age usually require the tube for from one to two weeks, older children for five days or less. Blocking of the tube with false membrane or thick mucus is usually an indication for immediate removal. In the majority of such cases the tube is expelled spontaneously. Before resorting to extraction, attempts may be made to get rid of the membrane by giving small doses of whiskey and water in order to excite coughing, or the child may be inverted and struck sharply on the back.

*Dangers and Difficulties of the Operation.*—There are no dangers to life at the hands of an expert operator from the operation itself. No physician should undertake to intubate a living child without thorough practice on the cadaver. Without such experience, tracheotomy is much to be preferred, for the field of operation is then beneath the eye of the physician. Dangers from the operation in unskilled hands are: asphyxia from prolonged and awkward attempts at intubation, laceration of the soft parts, with the extractor as well as the tube, and the making of false passages, generally through the ventricles of the larynx.

"Pushing down false membrane" has been erroneously made responsible for many deaths during the operation. This accident occasionally occurs, in which case the tube should be quickly removed by the still attached string when the membrane will usually be expelled. In some cases it may be necessary to use false membrane tubes for a little while.

Subglottic stenosis (so-called œdema) may rarely be the cause of difficulty in performing intubation. This occurs at the cricoid division of the larynx (the narrowest part) and may necessitate a certain degree of force in order to push the tube through the constriction.

*Retained Tube.*—Conditions requiring frequent re-intubations are: persistence of the laryngeal membrane, œde-

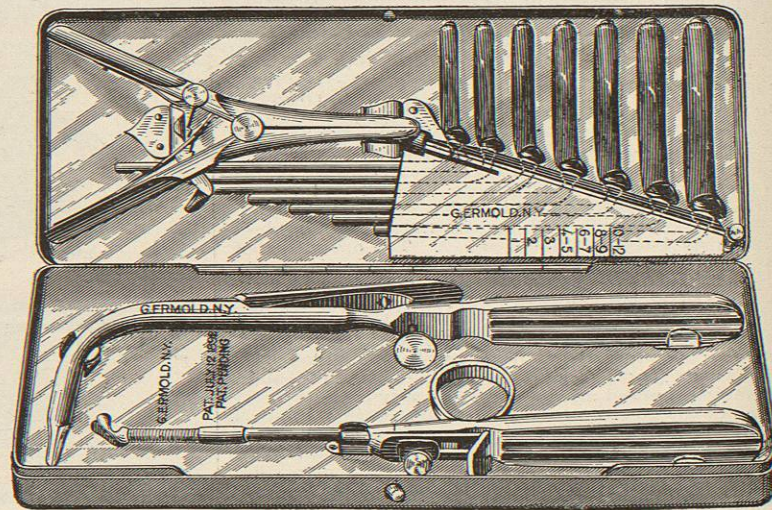


FIG. 2949.—Latest Design of Case Containing a Set of O'Dwyer's Instruments.

ma, ulcerations about the cricoid cartilage, leading occasionally to collapse of the cartilaginous framework of the larynx, cicatricial contractions, granulations, and abductor paralysis.

*Care and Feeding of Intubated Children.*—In the majority of cases of intubation the children soon learn to take food in the ordinary way. If, however, this is not possible, Casselberry's position may be necessary at least for a short time. In this method the patient's head hangs back over the lap of the nurse at an angle of forty-five degrees, the feet are elevated on a chair, and food is given with a spoon or from a bottle.

Gavage is preferred by some physicians during the entire time of intubation. It is certainly contraindicated when the pharynx is congested and painful. Rectal feeding should be regarded as a last resort. Semi-solids are more easily taken than liquids. Food should be given at short intervals and in such quantities as the child will take.

Nasal irrigation in cases of concurrent nasal diphtheria, is not contraindicated in intubated cases. Pharyngeal irrigation had best be omitted. To avoid the necessity of reintubation Dover's powder, gr. i., or morphine sulphate, gr.  $\frac{1}{10}$ – $\frac{1}{2}$ , may be given a short time before the tube is removed, and repeated afterward if necessary. Other useful measures to the same end are hot poultices over the throat, hot baths, and steam inhalation. Calming and amusing the child are also of great service.

The more recent statistics of intubation show that with the early use and proper dosage of antitoxin the operation detracts but little if at all from the chances of recovery from laryngeal diphtheria. Thus Waxham has reported forty intubations, with a mortality of five per cent.

The advantages of intubation over tracheotomy are in brief: That the former is bloodless, requires no anæsthetic or the help of trained assistants, is performed in a few seconds, and the after-care of the patient is much less than in tracheotomized cases. Finally, it would seem to be very poor judgment on the physician's part to inflict an open wound in order to tide a patient over a difficulty often (with the use of antitoxin) of only a few hours' duration.

Intubation for the relief of chronic stenosis due to cicatrices from wounds, syphilitic lesions, etc., as well as for the removal of a retained tracheotomy cannula, was suggested and practised by Dr. O'Dwyer with excellent results. The details of the operation cannot here be entered into. Suffice it to say that its success depends largely on the ingenuity and skill of the operator in having tubes fashioned to the various conditions encountered.

William P. Northrup.  
Matthias Nicoll, Jr.

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**INTUSSUSCEPTION.**—The prolapse of one part of the intestine into the lumen of the adjoining part is called an intussusception. The included portion is called the intussusceptum, the receiving portion the intussusciptiens. The condition is uncommon, and many physicians of large experience have never seen a single case. Among 12,641 cases of disease of which the diagnosis is recorded in recent hospital reports in New York City, there are only two such cases. Much attention, however, has recently been called to the condition, and the increasing number of reports suggests that when the possibility of

this condition is in the mind of the examiner the diagnosis will be made more frequently.

**CAUSE.**—Little is definitely known of the cause of intussusception. In peristalsis there are temporary contractions of the circular muscle fibres of the intestine. It

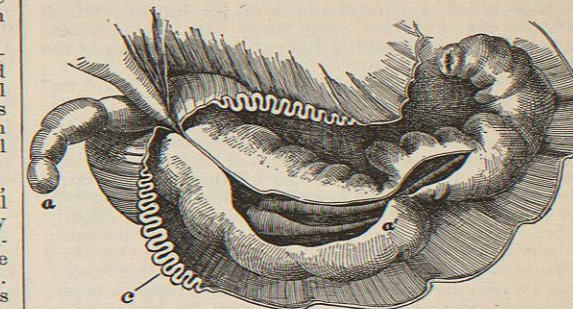


FIG. 2950.—Intussusception. (After Braun.) The lower end of the ileum, the cæcum, and a part of the colon have prolapsed into the colon. *a*, Appendix vermiformis; *a'*, cæcum; *c*, wrinkling of sheath which permits much mobility.

is easily conceivable that in rare instances, under certain irritations, this contraction should be prolonged and that the contracted part, with or without the action of the longitudinal fibres, should slip into the lumen of the adjacent part of the intestine and thus form an intussusception; and it is generally believed that most intussusceptions are formed in this way. A polypus or other new growth or a foreign body may also drag on the intestine and thus invaginate it. Leichtenstern,<sup>1</sup> in studying the records of 320 cases, found that polypi were present in 30 and that in 34 others there were cancers, strictures, masses of undigested food, or other foreign bodies.

**Occurrence.**—The condition occurs generally in children. Curtis,<sup>2</sup> in his comprehensive article in the former edition of this work, gives the following table of ages:

Age.	Acute cases. Per cent.	Chronic cases. Per cent.
Before 11 years .....	53	28
Between 11 and 20 years .....	12	10
Between 21 and 40 years .....	20	47
Between 41 and 60 years .....	11	12
Over 60 years .....	4	4

He found that children not over one year of age furnish 29 per cent. of the cases of intussusception.

The location of the intussusception is most commonly at the ileo-cæcal opening.

Leichtenstern found the following distribution: Ileo-cæcal, 44 per cent.; enteric, 30 per cent.; colic, 18 per cent.; ileo-colic, 8 per cent. The cases of intussusception in the small intestine were almost entirely confined to the ileum and the lower part of the jejunum. There are, however, records of a very few rare cases of intussusception of the duodenum.

Curtis noted that three-fourths of the cases in children under one year of age were ileo-cæcal, the mobility of the cæcum and entire colon being greater in early life.

**SYMPTOMS.**—The symptoms which are most commonly present are the following: 1. Abdominal pain. 2. Vomiting. 3. Constipation. 4. The presence of a tumor within the abdomen. 5. The passage of blood and mucus from the rectum. 6. The presence of the intussusceptum so near the rectum that it can be felt by the finger. 7. Shock.

*Pain* usually comes on suddenly, often without any preceding illness or injury. The patient usually twists and turns until he has reached the position which is least uncomfortable, possibly flexing the thighs on the body.

*Vomiting* is usually persistent, first of the stomach

contents, then of the intestinal contents; the character of the material vomited depends on the site of the constriction, and it need not be distinctly fecal. Persistent vomiting should always lead one to examine very carefully for the other symptoms of intussusception.

Constipation must of course be present when the intestine is occluded, but the contents of the intestine which are below the occlusion come away with the enemata, and this may be misleading during the early hours of the condition.

**Abdominal Tumor.**—The intussusception may frequently be felt within the abdomen. It is generally described as a sausage-shaped mass, usually lying near the ileo-caecal region. The possibility of feeling it depends largely on the presence or absence of inflammation and tympanites. If there is enough inflammation to cause reflex rigidity of the abdominal muscles, it may be difficult or even impossible to feel the mass; if this rigidity is excessive and if there is tympanites, it will probably be impossible to distinguish the mass without putting the patient under the influence of an anaesthetic. Sometimes a very long piece of the ileum slides into the colon, and it may even pass through its entire length as far as the rectum; in such instances instead of a sausage-shaped tumor there would be a tumefaction throughout the entire length of the colon, which might be very indefinite to the touch. Again, in very rare instances the intussusception is in the upper part of the intestine close under the liver, where it cannot be felt. It may be under the ribs, and hence impalpable, even when it is located lower in the small intestine. Erdmann<sup>2</sup> states that in three of his nine cases no tumor could be found before operation, although the ablest of pediatric diagnosticians had carefully palpated the subjects. Operation was, however, performed on account of the symptoms, and in two of the cases the tumor was found under the ribs in the left hypochondriac region; in the third it was under the right lobe of the liver.

**The Passage of Blood or Bloody Mucus** from the rectum is a most important aid to diagnosis. When it occurs in conjunction with the symptoms already enumerated, it makes the diagnosis almost certain. In the cases in which operation has been done it has been among the most commonly recorded symptoms. In 150 cases studied by Gibson,<sup>4</sup> in which the record of symptoms was not complete, a bloody discharge from the rectum was recorded 38 times; vomiting, 25 times; intussusception felt through the rectum, 23 times; discharge of mucus, and tenesmus, 12 times.

**The Palpation of the Intussusception through the Rectum** is of course proof positive of its existence; an effort should always be made to feel it there in suspected cases. Its presence is recorded in one-sixth of the cases in Gibson's table.

**Shock and Exhaustion** may or may not be present. Curtis states that as a rule the little patients remain in good condition until suffering and want of food lead to exhaustion. The writer's experience corresponds to this. Erdmann found shock present in the majority of his cases.

One cannot expect to find all of these symptoms in a single case, but a routine search should be made for all of them in every child who has persistent vomiting.

**TREATMENT.**—Success in the treatment of this condition depends largely upon promptness in diagnosis. There is hardly a condition in medicine or surgery in which an early and definite diagnosis is more important for the patient. Before adhesions have formed, the intussusception can be reduced with ease. When firm adhesions have formed, reduction is difficult. When the intussusception has become gangrenous, the condition is one of the most formidable known to surgery.

Only two methods of treatment need be considered: (1) The injection of liquids or gas by the rectum; and (2) operation. The operative method is coming more and more into prominence; the use of enemata is being made more subordinate each year. Many children have died under treatment by enemata who could have been saved by prompt operation.

The objections to enemata may be thus stated: (1) They may delay operation until it is too late; 2, they may rupture the intestine; (3) it is very difficult to determine whether the intussusception has been reduced by them; (4) if the intussusception has been reduced, it is much more likely to recur than when a fold has been made in the mesentery and stitched according to Senn's method. These objections are based upon the records of cases. Gibson, whose entire tabulation includes two hundred and thirty-eight cases in which operation has been done, gives examples to show how real they are.

The first objection is perhaps the most important. If the diagnosis is once made, relief should be obtained without delay; an intussusception should be dealt with as promptly as a strangulated hernia, and the giving of enemata and waiting to study the result is apt to cause most dangerous delay.

The following cases<sup>4</sup> show the danger of perforation: A child of five years (case recorded by Harrington) was given an enema under a hydrostatic pressure of four and one-half feet, on the fifth day of the intussusception, and the ileum was found to be perforated as a direct result of the pressure. Fenwick records a fatal perforation which occurred in a child of six months, following an enema which was given on the second day of the illness. Reduction apparently occurred, but the child died almost immediately, and the autopsy showed ulceration and perforation of the gut, the intussusception not having been reduced. Parkes cites a case in which an injection of one pint in a three-months-old child caused a perforation in the lower part of the intussusception, which was found at the autopsy.

A change in the size or location of the invagination or a partial reduction may be easily mistaken for a complete reduction. Instances of this are also recorded in Gibson's tables.

Gibson also calls attention to many instances of the return of the intussusception after it had once been reduced by enemata. Of course this may occur after operation, but if the mesentery is folded longitudinally and then stitched it is less likely to do so.

The following rules for the use of rectal injections may be given:

1. Only water or bland liquids should be used, since the pressure of air or other gases cannot be accurately measured.

2. The column of liquid should not be more than three feet high. Pick<sup>4</sup> limits the height to three feet and the amount to one and one-half pints for a child under one year of age.

3. Enemata should be used only in the early stages of the intussusception. Gibson would limit their use to the first two days. He found that in at least three of the cases recorded as treated on the first day of the disease, more than a simple reduction of the intussusception was needed; in one of them the colon was beginning to slough. Erdmann considers the use of enemata justifiable in all cases of less than twenty-four hours' duration.

4. If the enema is to be given, all the preparations for operation should be made, and unless there is definite proof that the intussusception has been reduced the abdomen should be opened.

**Operation.**—The operation of choice is the opening of the abdomen and the reduction of the intussusception by manipulation and pressure from below without pulling on the intestine. A plait may then be stitched in the mesentery in the hope of preventing a recurrence.

The use of enemata to aid in this reduction after the abdomen has been opened may be of very great assistance. Brewer<sup>5</sup> reports a case of five days' duration in which a part of the ileum, the caecum, and nearly half of the colon had prolapsed into the remaining part of the colon so as to be palpable at the rectum; dense adhesions were present, but the patient was put in the Trendelenburg posture and the rectum distended by saline solution. By the combined use of taxis, traction, pressure of saline solution, and the manual breaking up of adhesions be-

tween the ileum and colon, the intussusception was finally reduced and the patient recovered.

There are many instances in which the reduction of the intussusception has been impossible. The intestinal wall, when deprived of its circulation and subjected to so much pressure, becomes weakened and may rupture even under very gentle manipulation; or the operator may see that further manipulation will rupture it, and hence decide to do a resection at once.

Under these conditions the following procedures are to be considered:

1. Resection of the diseased intestine and union of its ends by suture or by a Murphy button.

2. Removal of the intussusception through a longitudinal opening in the intestine which holds it, and suture of the intestinal walls where the intussusception enters the intussusciptens.

3. The formation of an artificial anus in the hope of restoring the continuity of the intestine at a later time.

Intestinal resection and union of the divided ends is the operation of choice, and will probably save more lives than any other method of dealing with the condition. It has two distinct advantages over the second method: (1) The section may be so placed that healthy parts of intestine are used for approximation; (2) there is the minimum danger of sepsis from handling of the inflamed intussusception.

There are, however, instances in which the second method is preferable. For example, in the case of an intussusception in the large intestine when the lack of mesentery makes approximation of the ends of the intestine very difficult, it may be better to take advantage of adhesions which already exist at the upper margin of the invagination.

It is generally conceded that an end-to-end union is better than a lateral anastomosis, as there is less danger of cicatricial contraction. Whether the end-to-end union should be made with a Murphy button or by suture depends on the practice of the individual surgeon. The present tendency is to use Murphy buttons. In intestinal resection after strangulated hernia they have been of great aid. Peterson,<sup>6</sup> for instance, in studying the cases from Czerny's clinic in Heidelberg, reports 15 cases of primary resection with 8 deaths prior to 1898, a mortality of 60 per cent.; and 12 primary resections with 1 death since 1898, a mortality of 8 per cent. He ascribes the improvement to the use of the Murphy button and to the employment of local anaesthesia.

The conditions in intussusception are not so favorable for the Murphy button. The cases are usually in children and a button of very small size is necessary, and this may be difficult to use in the distended upper part of the intestine, unless it is inserted in the side of the gut. Again, in these operations of emergency the proper button may not be at hand.

End-to-end suture, with the first row of sutures including all the intestinal coats and carried over the intestinal margins, and the second row going to and including the submucous layer, may be relied upon as an efficacious method.

The formation of an artificial anus is not usually to be advised. It is conceivable that in a case of dire urgency the intestine may be drawn through the abdominal opening and left there, but the results from this procedure are very discouraging. Unless the opening is in the lower part of the intestine life is maintained with difficulty, and even then there is an irritating and disagreeable discharge, and the necessity still exists for a secondary operation which of itself has a high mortality rate. Peterson<sup>6</sup> has recently considered with great care the relative advantages of intestinal resection and artificial anus in cases of strangulated hernia. The mortality in 22 artificial-anus cases was 67 per cent., and in 28 resection cases 33 per cent. He quotes numerous authorities, among them Zeidler,<sup>7</sup> who has analyzed 213 cases treated by artificial-anus formation and 269 cases treated by intestinal resection, and concludes that the higher mortality rate of the former was not due to the nature of the cases

prior to operation. He suggests that an additional 17 per cent. of the artificial-anus cases could have been saved by intestinal resection.

**Prognosis.**—The mortality from intussusception is very high, but it is diminishing from year to year. In the former edition of this work Curtis stated that it was 76 per cent. in 70 patients who had been operated upon from 1873 to 1887 inclusive. In 1891<sup>8</sup> he found it 70 per cent. in 105 cases. In 1897 Gibson found it 53 per cent. in 149 patients operated upon from 1888 to 1896 inclusive.

A reduction from 76 to 53 per cent. is most encouraging. Still we must look with terror on a disease which has a mortality of 53 per cent.; and when we realize that the mortality would probably be less than 10 per cent. if an early diagnosis could always be made, we must be impressed with our responsibility and the importance of considering all the elements which go to make this diagnosis; and we must realize the necessity for prompt action if the diagnosis is once made.

There is an enormous difference in the mortality of reducible and irreducible cases. Gibson found the former to be 38 per cent., the latter 82 per cent. He found only 10 cases of recovery after irreducible intussusception in his entire series of 238 cases dating back to 1869. There was no case of recovery from irreducible intussusception in a child under seven years of age. There was only one case of recovery from gangrenous intussusception; it was in a patient twenty-three years of age.

These figures, however, do not indicate the possibilities of intestinal surgery at the present time. Ludloff<sup>9</sup> reports four cases of intestinal resection and end-to-end suture for intussusception, with recovery. A fifth case was treated by intestinal anastomosis and terminated fatally. In a sixth case the invagination was reduced with difficulty, and abscesses formed about it, but there was final recovery.

The writer<sup>10</sup> has been so fortunate as to obtain a recovery from gangrenous intussusception of ten days' duration, in a boy four years old, by intestinal resection and end-to-end suture. We may confidently expect that we shall in the future know of many cases of recovery from irreducible intussusception.

The space allotted to this article does not allow of an exhaustive consideration of all the topics. For such a consideration the reader is referred to the literature to which references are made.

Charles N. Dowd.

<sup>1</sup> Leichtenstern: Vierteljahrschr. f. prakt. Heilk., 1873.

<sup>2</sup> Curtis: REFERENCE HANDBOOK OF THE MEDICAL SCIENCES, New York, 1889, vol. viii.

<sup>3</sup> Erdmann: Annals of Surgery, July, 1900, p. 183.

<sup>4</sup> Gibson: Medical Record, July 17th, 1897, p. 72.

<sup>5</sup> Brewer: Annals of Surgery, September, 1900, p. 249.

<sup>6</sup> Peterson: Deutsch. med. Woch., 1901, Nos. 8-10.

<sup>7</sup> Zeidler: Cent. Chir., 1893, p. 62.

<sup>8</sup> Curtis: Medical Record, 1891, xl., p. 534.

<sup>9</sup> Ludloff: Centralblatt für Chir., 1893, p. 46.

<sup>10</sup> Dowd: Annals of Surgery, July, 1902.

**INVERTIN.**—An enzyme contained in the *succus entericus* which possesses a powerful hydrolyzing or inverting action upon cane sugar and maltose, causing in each case the taking up, by the disaccharide molecule, of the elements of a molecule of water and simultaneous cleavage into two monosaccharide molecules. There is thus formed in the case of cane sugar a mixture of equal quantities of dextrose and levulose, *i.e.*, invert sugar, and, in the case of maltose, dextrose alone in equivalent quantity is formed. The enzyme is stated to be inactive toward lactose, although it is present in the intestinal secretion at birth.

That the action is due to an enzyme is shown by the facts that it is not inhibited by the presence of antiseptics, and is at once destroyed by boiling the *succus entericus*. Benjamin Moore.

**IODANTIFEBRIN.**—C<sub>6</sub>H<sub>4</sub>INHC<sub>2</sub>H<sub>5</sub>O. This is prepared from acetanilid by substituting iodine for one hydrogen atom. It was prepared by Dr. Ostermayer, who also introduced iodantipyrrin. It is a white crystalline powder insoluble in cold, but soluble in hot water