CANTOR

INTESTINAL INTU

THOMAS

INTESTINAL INTUBATION

By

MEYER O. CANTOR, M.S., M.D., F.A.C.S.

Assistant Attending Surgeon
Grace Hospital
Formerly, Senior Attending Physician
Deaconess Hospital
Detroit, Michigan

CHARLES C THOMAS • PUBLISHER
Springfield, Illinois, U.S.A.

CHARLES C THOMAS • PUBLISHER
BANNERSTONE HOUSE
301-327 EAST LAWRENCE AVENUE, SPRINGFIELD, ILLINOIS

Published simultaneously in The British Commonwealth of Nations by
BLACKWELL SCIENTIFIC PUBLICATIONS, LTD.,
OXFORD, ENGLAND

Published simultaneously in Canada by
THE RYERSON PRESS, TORONTO

FIRST EDITION

Printed in the United States of America

DEDICATED TO

My wife, Lillian, whose constant encouragement and help, particularly during the early, trying days of experimentation, made this work possible.

PREFACE

The early papers of Ward, Wangensteen, Miller-Abbott and Johnston created a new era in the treatment of intestinal obstruction. By the use of suction applied to an indwelling gastroduodenal or intestinal decompression tube, it has been possible to reduce the mortality rate in cases of bowel obstruction from sixty per cent to less than sixteen per cent. That this reduction in mortality rate was not entirely due to intestinal decompression is a universally accepted fact. Our newer concept of water balance, for which we are deeply indebted to Coller and his associates, and our clearer understanding of the changes in intestinal physiology and physiological chemistry of the blood, played no small part in this reduction in mortality.

Intestinal distention, however, is one of the important disorders of intestinal physiology as a result of an interruption of the intestinal stream from *os orum* to *os anum*. For some time, surgeons throughout the world felt that by the use of the Levin tube the problem of intestinal distention had been solved. It was soon found that this was unfortunately not the case. The introduction of the Miller-Abbott and Johnston tubes in the treatment of bowel obstruction was the next logical evolutionary step in the solution of this problem. Here, it was again soon found that although many cases were greatly benefited, still the method of intubation required a high degree of "know-how" and usually the use of fluoroscopy in these very ill patients in order to get the tubes to pass through the pylorus. The literature, in the past seven years, is replete with articles describing the virtues of these tubes and the great difficulty so often experienced in passing them. The percentage of failures in many clinics ran as high as twenty per cent.[1] We were impressed by the necessity of finding a new type of tube and a newer concept of its passage through the gastrointestinal tract. We felt that in order to make the use of the

[1] Smith, B. C.: Miller-Abbott Tube; Statistical Study of 1,000 Cases. Ann. Surg., *122*:253-259, (Aug.) 1945.

tube "fool-proof" it should be constructed as simply as possible and must further satisfy four criteria.

The tube must have a lumen sufficiently large so that intestinal particulate matter would not plug it. In this way, the care of the tube by the nursing staff could be reduced to a minimum. The tube should be radio-opaque so that the roentgenologist would be in a position to know exactly where it is at all times and so that knots and kinks could be readily detected. The tube should further have a sufficient number of holes so that pocketing would not occur in cases of multiple short-loop obstructions. The holes should be of sufficient size so that they do not become plugged readily.

If such a tube could be passed far down the gastro-intestinal tract, the treatment of intestinal distention would be greatly simplified. Since the propulsive mechanism of all tubes resides in the "head" of the tube, and since we found after much experimentation and thought that mercury was the best medium to be used in the "head" of the tube, the problem of the propulsive mechanism merely resolved itself down to placing the mercury in a very loose bag at the very tip of the tube in order to utilize all the physical properties of mercury and not merely its weight.

During the early years of 1942, 1943, and 1944 many changes were made in the tube in order to make it as simple as possible. A newer concept of its downward passage has been developed in this process of development.

I wish to express my admiration and gratitude to Dr. Daniel J. Leithauser whose guidance and example has helped me to "steer a straight course." I should also like to express my appreciation to Dr. C. S. Kennedy who made it possible for me to carry on this study. Dr. Roland P. Reynolds was ever helpful particularly when the going was rough. I am indebted to all the doctors on the staff of Grace Hospital for the use of their cases during the developmental stages of our simplified tube. I am particularly indebted to Dr. Hans Jarre of our roentgen ray department whose suggestions were most helpful particularly in writing the chapter on the roentgenologist's role in intubation. I am greatly indebted to Dr. John R. Paine for his very excellent summary of the history of intestinal tubes. Everett R. Phelps,

Ph.D., and Robert H. Esling, M.S., collaborated in studying the effect of the tension of intestinal gases upon the balloon of intestinal decompression tubes. Dr. Phelps, head of the department of physics at Wayne University, placed the facilities of his department at our disposal to carry out this study. I should like to express my appreciation to the following journals for permitting me to abstract material freely: *The American Journal of Surgery; Surgery, Gynecology and Obstetrics; Annals of Surgery; Archives of Surgery; Journal of the American Medical Association; New England Medical Journal; Surgery;* and *American Journal of Digestive Diseases.* Last, but not least, I wish to thank my wife, Lillian, for the excellent sketches which help to clarify many points. I am deeply indebted to Frank Ruslander for the excellence of his photography.

I should like to express my appreciation to the firm of Charles C Thomas · Publisher, for many kindnesses throughout the process of compiling this material.

MEYER O. CANTOR, M.D.

Detroit, Michigan

CONTENTS

INTESTINAL INTUBATION

CHAPTER 1

INTRODUCTION

IN THE past ten years, intestinal intubation has come to occupy a very important position in the armamentarium of the surgeon in his attack upon intestinal distention. No thinking surgeon would deny the importance of decompressing the gastrointestinal tract in any case of severe distention, nor can we forget that in many cases such intestinal decompression is in itself a life-saving measure. Yet despite the importance of such intestinal decompression, the means of securing it, namely, intestinal intubation is generally intrusted to the interne who too often lacks an adequate understanding of the mechanism involved.

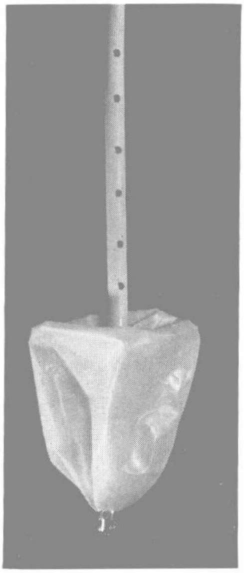
This past decade has seen tremendous improvements in intestinal decompression tubes, as well as in methods of obtaining a negative pressure to produce suction at the end of such intestinal decompression tubes. The indications and the contra-indications for the use of such tubes has gradually evolved as a result of the work of many surgeons working independently in different parts of the country. Much "water has passed under the bridge" since the early papers of Ward,[2, 3, 4] Westerman,[5] Kanavel,[6] and, Wangensteen and Paine[7] called the attention of the surgical world to the fact that a simple tube passed into the stomach of patients with ileus due to peritonitis would decompress these cases, as well as many post-operative cases of intestinal distention. In many cases, the Levin tube passed through the pylorus and decompressed the duodenum and upper jejunum. As long as the distention was chiefly gaseous such methods of decompression were adequate. This work furnished an impetus to surgeons everywhere and succeeded in creating an "intubation era."

The early work on gastro-duodenal intubation was soon followed by an attempt to pass such tubes far down the gastrointestinal tract into the colon, if need be, in order to treat intestinal distention. The demonstration by Paine[8] that negative pressure at the end of a gastro-duodenal tube could not effectively reduce the intra-luminal pressure in the ileum, and the clinical observations by surgeons everywhere that gastro-duodenal intubation was not sufficient to treat intestinal distention, resulted in a search for more effective methods. When Miller-Abbott combined the observations of Hotz,[9] that a balloon placed into the bowel would cause contraction of the bowel wall when the balloon was inflated, and the observations of Jones,[10] who studied intestinal pain by passing a balloon-tipped tube down the gastro-intestinal tract and noted contractions upon the inflated balloon, the result of combining both of these observations was the development of a balloon at the distal end of a double or triple lumen tube. It was noted that, if the bowel in front of the balloon were decompressed and the balloon inflated peristaltic waves would be set up as a result of the inflated balloon acting like a bolus. In this way, such tubes were carried down the gastro-intestinal tract in order to study the intestinal physiology and the flora at different levels of the gastro-intestinal tract.

Johnston, in 1938,[11] used these long tubes in cases of bowel obstruction. The need for a tube that would pass down to the point of obstruction was recognized by Johnston with the result that an attempt was made to utilize the Miller-Abbott tubes for this purpose. Surgeons everywhere were quick to recognize the great value of having a tube down to the point of obstruction. The use of the Miller-Abbott tube became wide-spread.

It was realized very shortly thereafter that there were many drawbacks to the use of the Miller-Abbott tube in cases of bowel obstruction. Some of these drawbacks were due to the fact that the tube itself was not the answer to the problem of intestinal distention, and some of the drawbacks were due to the improper selection of cases for intubation and a lack of proper understanding of just what one could accomplish by intubation.

Since 1938, much work has been done in order to more successfully treat intestinal distention and to clarify just when, where, and how, these tubes should be used. Several different types of tubes have been introduced with the objective of intubating successfully a higher percentage of cases with less effort and with tubes giving a maximum diameter of decompression. Each tube was evolved by a surgeon to meet certain physiological criteria which he thought necessary to propel the tube down the gastro-intestinal tract. Classifying our tubes in use today by this standard, four different types of tubes based upon four different principles of propulsion are found in use today.



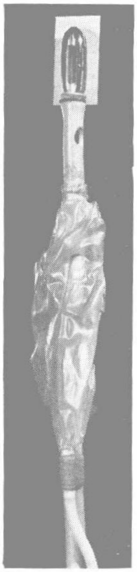


Figure 1 Figure 2

Figure 1. Tube head of Miller-Abbott tube. Balloon along the shaft of the tube at its distal end. Balloon to be inflated with air. Note perforated metal end projecting beyond the balloon. This is a double lumen tube inclosed in one sheath.

Figure 2. Tube head of Johnston tube. Here the double lumen tubes are not inclosed in one sheath. The small tube is used for inflation of the balloon and the large tube for decompression. Note that the balloon is attached along the shaft of the distal end of the tube and note how the tube tipped with a metal piece projects beyond the balloon. Note fenestrations in metal tip of tube.

The Miller-Abbott tube[12] which is based upon the principle, "that it is necessary to decompress the gut in front of the balloon, so that when the balloon is inflated it acts like a bolus and is so propelled down the bowel," would then be called a double lumen "air-filled bolus type tube." Successful intubation can be obtained in a good percentage of cases using this type of tube if one is willing to spend the time and use fluoroscopic control. Once the patient is successfully intubated with this type of tube its downward progress is generally rapid. However, being a double lumen tube with a small lumen for decompression a great deal of nursing care is required to keep the decompressing lumen open. There are many modifications of this tube utilizing the same propulsive principle. These tubes are double lumen with both lumina inclosed in the same sheath.

In the same classification as the Miller-Abbott tube one would find the Johnston tube.[13] Here, we find a double lumen tube based upon the same propulsive mechanism, but to avoid the disadvantage of the small lumen used for decompression, the two lumen are not in the same sheath, but are made by the coaptation of two tubes side-by-side. A small tube to inflate the balloon and a larger lumenal tube for decompression.

The Aguiar tube[14] which was introduced in Brazil is a single lumen tube based upon the principle of "jet-propulsion." The principle upon which this tube was based is the concept of the surgeon that by injecting a liquid or air or liquid and air forcibly into a single lumen tube the emission of this solution at an acute angle at the head end of the tube results in its downward propulsion. This type of tube is not available in North America. Most surgeons are very loath to inject any fluid or air and fluid into a gastro-intestinal tract already filled with gaseous and liquid material. Although American surgeons do not use this type of tube, nevertheless, the development of a tube based upon the "jet-propulsion" principle has been of great value in helping to crystallize our ideas as to the type of tube that would most perfectly fill the surgical requirements to induce successful intestinal intubation.

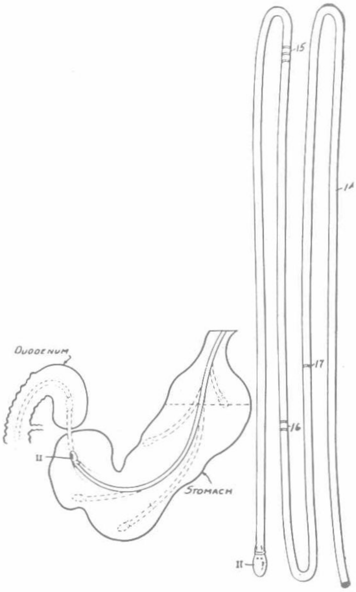


Figure 3. The Aguiar tube. This is a "jet-propulsion" tube. The liquid or air and liquid is injected into the tube and emerges obliquely to the wall of the bowel through the metal tube head. The force of this stream propels the tube along.

As early as 1908, weighted gastro-duodenal tubes came into being with the reports of Einhorn[15] and Gross[16] working independently. In the next ten years, a multiplicity of gastro-duodenal tubes were developed all based upon the principle of "weight" of the head end of the tube as a propulsive mechanism. Many metals were employed in obtaining such weighted heads. Gold, silver, lead, and mercury all had their proponents and were used in the head of a tube to weight it so that gravity would carry the

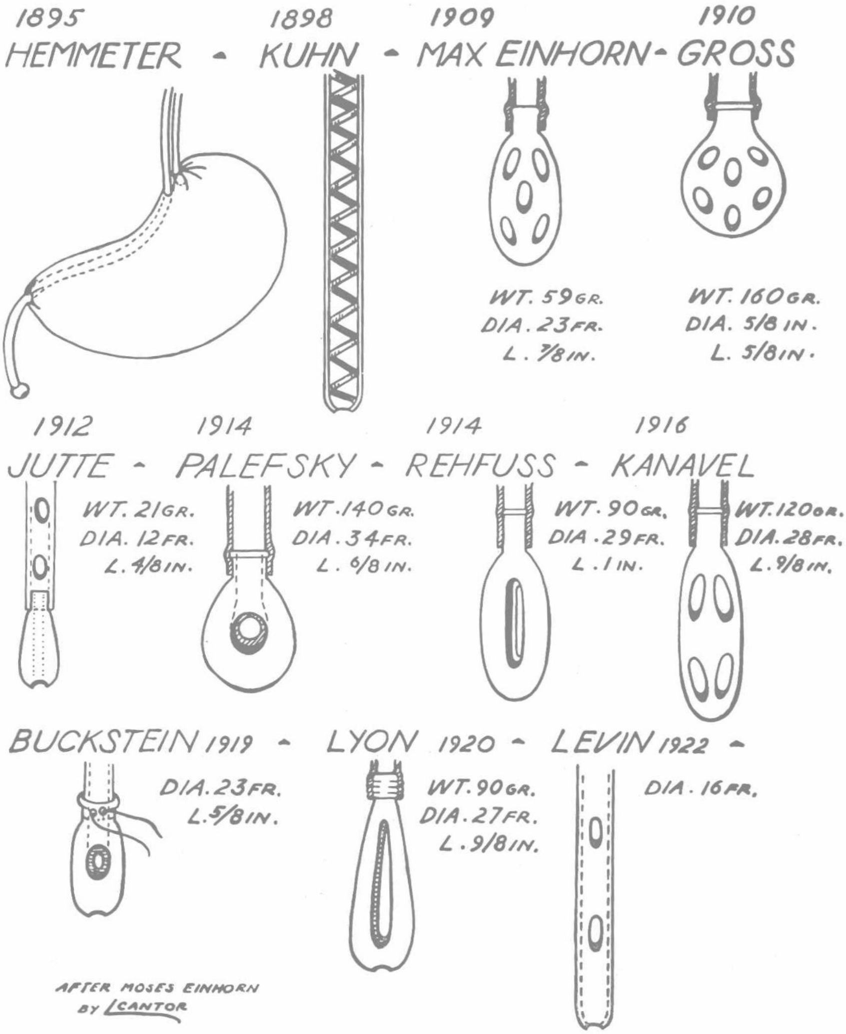


Figure 4. Note the evolutionary changes in gastro-duodenal tubes from the time of Hemmeter in 1895. Note particularly the attention given to the weight of the head and its shape. These were considered to be of the greatest importance in insuring successful duodenal intubation. (From: Moses Einhorn: "New Bucketless Lead Weighted Gastro-duodenal Tube with a Review of the American Contribution to the Development of These Tubes." Am. J. of Digest. Dis., *5*:77-80, 1938)