Change in Mechanical Bowel Obstruction Demographic and Etiological Patterns During the Past Century

Observations From One Health Care Institution

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Objective: To compare epidemiological analysis concerning sex, age, location of blockage, and frequency of occurrence of etiological factors in 2 groups of patients treated for mechanical bowel obstruction 100 years apart.

Design: Epidemiological analysis of patients undergoing an operation for small-bowel obstruction (SBO) or large-bowel obstruction (LBO) from 1868 to 1898 (group 1) and from 2000 to 2003 (group 2).

Setting: Second Clinic of Surgery of the Jagiellonian University Medical College.

Patients: One hundred ninety-three patients in group 1 and 207 in group 2.

Main Outcome Measure: Change in demographic and etiological patterns of mechanical bowel obstruction during the past 100 years.

Results: In both groups, the prevalence of bowel obstruction was similar in particular segments of the intestine (approximately 75% for SBO and 25% for LBO). The primary cause of SBO in group 2 remained incarcerated abdominal hernia (30.8% for group 1 compared with 55.0%). The second most common cause of SBO was intraperitoneal adhesions (29.4% compared with 34.4%). Isolated small-bowel volvulus as the cause of bowel obstruction decreased significantly (P ≤ .05) (16.8% compared with 2.7%). Significant changes were also observed in the etiology of LBO. A century ago, the most common cause was volvulus of the sigmoid colon or of the cecum (72.0%); in the later group, obstruction was caused by cancer in 80.4% of cases.

Conclusions: During the past 100 years, no changes were observed concerning the location of bowel obstruction or the patients' sex. Etiological factors in SBO and LBO changed significantly. The age of surgical patients also increased significantly.

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Despite profound knowledge of the pathophysiological features of bowel obstruction and improving diagnostic options, the disorder is a serious problem confronted by surgeons every day, with a significant mortality of approximately 10% to 15%.1 It is estimated that in Poland more than 20% of emergency operations on the abdominal cavity are owing to mechanical bowel obstruction.2 Therefore, it is worth comparing and analyzing the records of patients treated for this disorder at the end of the 19th century and the beginning of the 21st century at the same hospital, the Second Clinic of Surgery of the Jagiellonian University Medical College in Kraków. The hospital is the heir of the Surgical Department of the St Lazarus Hospital founded in Kraków in 1799 and continues the tradition and activity of the older institution.

A very special role in the development of this department was played by the long-time chief of the Second Clinic of Surgery, Alfred Obalski, PhD (Figure 1). Obalski was born in 1843. From 1862 through 1867, he studied at the Medical Faculty of the Jagiellonian University in Kraków. In 1868, he earned a doctoral degree in medicine and became an assistant professor at the Surgical Department of the St Lazarus Hospital in Kraków. In 1870, he became head of this department and a few years later was appointed professor of surgery; he held this position until his premature death at 55 years of age in July 1898. On his initiative, the very modern 120-bed surgical pavilion of the St Lazarus Hospital (Figure 2) was built and commissioned in 1893.

See Invited Critique at end of article
Obaliński developed many innovative methods of surgery and principles of surgical proceedings recognized in the European reference literature. He performed operations not only on the abdominal cavity but also in such fields as orthopedics, neurosurgery, urology, and gynecology, as was quite common at that time. Obaliński introduced his own method of skull trepanation (still used today), which consists of sawing the cranial bones from the inside with the use of a Gigli saw. He is also considered a pioneer of diagnostic radiology in surgery in Poland. In February 1896, within a year of Wilhelm Röntgen’s discovery of x-rays, he used these to confirm the diagnosis of posterior elbow dislocation in a patient. Owling to inaccuracy of the tube emitting x-rays and gross edema of the soft tissues, receiving the image of the bones was characterized by Obaliński and colleagues as the so-called acute and subacute blockage (at present referred to as obstructive peristalsis). He declared it a pathognomonic sign of acute bowel obstruction triggered by a sudden mechanical blockage.8

In Obaliński’s time, most practitioners (including surgeons) believed that patients with mechanical bowel obstruction should undergo conservative treatment. Obaliński’s theories were innovative, revolutionary changes in the treatment of bowel obstruction. He believed that opening the abdominal cavity and removing the blockage in mechanical bowel obstruction was the only proper treatment. He recommended early surgical intervention before the patient’s strength and condition deteriorated.9,11

Obaliński intended to analyze the clinical material that was the subject of his academic output. Unfortunately, this work was interrupted by his death. His assistants claimed to be the heirs and executors of his academic last will and decided to continue his work, which resulted in the publication by the Jagiellonian University Printing House in 1899 of the work entitled Zbior Prac ku Uczczentu Pamięci Prof. dr Alfreda Obalinskiego [A Compilation of Studies Published in Commemoration of Professor Alfred Obaliński, PhD] by the circle of his last students and colleagues.

This work includes 2 chapters, “Mechanical bowel obstruction: 156 cases” by Maksymilian Rutkowski, MD, PhD,12 and “The results of primary gangrenous bowel resection in obstructed hernias” by Ryszard Urbanik, MD, PhD.13 These studies provide a unique opportunity to compare the clinical material of patients treated for mechanical bowel obstruction by our predecessors at the end of the 19th century with the population of patients treated for the same disorder at the same institution at the beginning of the 21st century.

Our analysis is based on 30 years of clinical material (1868-1898) compiled by Obaliński and his colleagues from cases at the St Lazarus Hospital (193 patients; group 1) and consecutively admitted emergency cases treated at the Second Clinic of Surgery of Jagiellonian University Medical College for mechanical bowel obstruction from January 1, 2000, through December 31, 2003 (207 patients; group 2).

In both populations we calculated the numbers and percentages of cases of mechanical obstruction of the small intestine (SBO) and large intestine (LBO). To perform more exact comparisons with our own cases regarding the location, causes, and prevalence rate of various types of bowel obstruction, we rearranged the cases from Obaliński and colleagues according to contemporary criteria in such a way that the patients with bowel obstruction caused by volvulus of the mesentry of the sigmoid colon, cecum, or small intestine (Table 1) were classified as having intestinal volvulus (Table 2). The patients with incarcerated hernia and so-called falsely repositioned hernias (Table 1) were classified as having incarcerated hernias (Table 2). Patients with obstruction caused by intestinal strangulation, “subcaecal hernia,” angular bending, or adhesions after dysentery, typhoid fever, or tuberculosis (Table 1) were classified as having obstruction due to strangulation (Table 2). Cases characterized by Obaliński and colleagues as the so-called acute and...
chronic intussusception (Table 1) were classified as having intestinal intussusception (Table 2).

RESULTS

Group 1 consisted of 193 patients (mean age, 42.5 years), including 100 men (51.8%; mean age, 40.5 years) and 93 women (48.2%; mean age, 44.5 years) (Table 1). Group 2 consisted of 207 patients (mean age, 62.9 years), including 95 men (45.9%; mean age, 65.5 years) and 112 women (54.1%; mean age, 60.7 years).

In both groups, the occurrence of mechanical bowel obstruction with regard to each sex was similar. The ratio was and still is approximately 1:1; however, in group 2, the number of women undergoing operation for bowel obstruction increased by 8.4% and the number of men decreased by 3.5%.

In the 21st century, the average lifespan is much longer in women and men, which is reflected in the comparison. The mean age of surgical patients of the whole modern population was higher by more than 20 years (among women, 19.3 years; among men, 22.0 years) compared with the population from the end of the 19th century.

Although a century has passed, the location of blockage within the intestine did not change much between groups. About 75% of all cases involve the small intestine and 25% the large intestine. The frequency of occurrence of particular etiological factors has changed. In group 2, volvulus of the bowel mesentery is far less frequent (4.8% vs 31.1%). The percentage of isolated small-bowel volvulus as the cause of bowel obstruction decreased significantly from 16.8% to 2.7%. In group 1, 12.4% of cases of bowel obstruction were caused by intussusceptions, mainly in the ileocecal portion, whereas in group 2, this type of bowel obstruction was not observed.

Analysis of the frequency of factors triggering bowel obstruction revealed that incarcerated abdominal hernia (predominantly inguinal, femoral, and umbilical) are the primary cause of SBO in both study periods. The percentage increased from 30.8% to 55.0% between groups. The second most common cause of SBO was intraperitoneal adhesions, which increased from 29.4% in group 1 to 34.4% in group 2. However, nearly 100% of adhesions in group 2 were casually related to previous surgical procedures within the abdominal cavity. In group 1, all the cases of adhesions resulted from a bacterial infection of the peritoneum (eg, typhoid fever, dysentery, or tuberculosis). The most frequent cause of obstruction in group 1 was volvulus, or torsion of the mesentery; the frequency of this form of bowel obstruction decreased from 31.1% to 4.8% in group 2.

In group 1, 16.1% of cases of SBO were caused by intussusception, mainly in the ileocecal portion, whereas this type of bowel obstruction was not observed in group 2. A very rare form of SBO observed only in group 2 was caused by inflammatory lesions (Crohn disease) of the small intestine (2.6% of SBO).

In the case of LBO, etiological factors changed significantly. In group 1, volvulus (torsion) caused 72.0% of LBO cases. In group 2, this form of obstruction caused only 10.7% of LBO cases. The most frequent cause of LBO in group 2 was obstruction of the intestinal lumen by a growing tumor (cancer). The prevalence of this form of bowel obstruction increased from 26.0% in group 1 to 80.4% in group 2. Inflammatory lesions of the large intestine (diverticulitis) were a rare cause of LBO; this form of bowel obstruction was present in group 2 only (3.6%).

COMMENT

The mean age of surgical patients of the whole population these days has increased by more than 20 years compared with the population from the end of the 19th century. Of particular interest is the juxtaposition of the mean age of the surgical patients a century ago and at present with the average lifespan of the respective populations.

Finding relevant data from the late 19th century for Kraków and Galicia (this region of Poland was part of the Austro-Hungarian Empire till 1918) is not an easy task because of incomplete demographic statistical data; however, from estimated data we may assume that the average lifespan in Galicia during the first study period was approximately 39 to 42 years, whereas in Poland it is now 72.8 years for men and 80.6 years for women. Based on these data, we might assume that 100 years ago, the mean age of patients undergoing an operation for bowel obstruction was comparable to the average lifespan of the whole population. The 21st-century surgical patients underwent the procedure at 85% of their lifespan. It could therefore be argued that, although the 21st-century patients were older on average by more than 20 years, they can actually be considered biologically younger owing to the assumption that their age is related to the average lifespan in the periods concerned.
The passage of a century brought about significant changes in etiological factors as far as SBO and LBO are concerned, such as a significant decrease in the prevalence of volvulus. The most common sites of volvulus are the sigmoid colon and cecum. Volvulus has variable geographic and racial distributions and, although common in developing countries, has a much lower incidence in Europe and the United States. The etiology of volvulus remains speculative. Although chronic constipation is blamed for the European type of volvulus, a high-

### Table 1. Causal Factors in Patients With Mechanical Bowel Obstruction

<table>
<thead>
<tr>
<th>Causal Factor</th>
<th>All Patients</th>
<th>Men</th>
<th>Women</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No. (%)</td>
<td>Mean Age, y</td>
<td>No. (%)</td>
</tr>
<tr>
<td>Volvulus of the sigmoid colon</td>
<td>31 (16.1)</td>
<td>42.6</td>
<td>22 (71.0)</td>
</tr>
<tr>
<td>Volvulus of the ileum</td>
<td>24 (12.4)</td>
<td>42.9</td>
<td>19 (79.2)</td>
</tr>
<tr>
<td>Volvulus of the cecum</td>
<td>5 (2.6)</td>
<td>39.8</td>
<td>3 (60.0)</td>
</tr>
<tr>
<td>Strangulation</td>
<td>16 (8.3)</td>
<td>34.3</td>
<td>6 (37.5)</td>
</tr>
<tr>
<td>Subcecal hernia</td>
<td>1 (0.5)</td>
<td>37.0</td>
<td>1 (100.0)</td>
</tr>
<tr>
<td>Acute intussusception</td>
<td>15 (7.8)</td>
<td>51.3</td>
<td>9 (60.0)</td>
</tr>
<tr>
<td>Chronic intussusception</td>
<td>9 (4.7)</td>
<td>35.7</td>
<td>6 (66.7)</td>
</tr>
<tr>
<td>Angular bending</td>
<td>10 (5.2)</td>
<td>39.2</td>
<td>3 (30.0)</td>
</tr>
<tr>
<td>Widespread adhesions (typhoid fever, dysentery)</td>
<td>7 (3.6)</td>
<td>41.1</td>
<td>2 (28.6)</td>
</tr>
<tr>
<td>Intestinal compression</td>
<td>4 (2.1)</td>
<td>47.2</td>
<td>0</td>
</tr>
<tr>
<td>Oburrination</td>
<td>3 (1.6)</td>
<td>60.0</td>
<td>0</td>
</tr>
<tr>
<td>Obstruction due to cicatization</td>
<td>3 (1.6)</td>
<td>42.3</td>
<td>2 (66.7)</td>
</tr>
<tr>
<td>Intestinal tuberculosis</td>
<td>8 (4.1)</td>
<td>28.0</td>
<td>2 (25.0)</td>
</tr>
<tr>
<td>Intestinal cancer</td>
<td>13 (6.7)</td>
<td>47.9</td>
<td>7 (53.8)</td>
</tr>
<tr>
<td>Incarcerated hernia, gangrene</td>
<td>37 (19.2)</td>
<td>45.0</td>
<td>12 (32.4)</td>
</tr>
<tr>
<td>False hernia repositioning</td>
<td>7 (3.6)</td>
<td>40.4</td>
<td>6 (85.7)</td>
</tr>
<tr>
<td>All</td>
<td>193 (100.0)</td>
<td>42.5</td>
<td>100 (51.8)</td>
</tr>
</tbody>
</table>

### Table 2. Between-Group Comparison of the Location, Frequency, and Causal Factors of Mechanical Bowel Obstruction

<table>
<thead>
<tr>
<th>Causal Factor</th>
<th>Group 1</th>
<th>Group 2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>All (n = 193)</td>
<td>SBO (n = 143)</td>
</tr>
<tr>
<td>Intestinal volvulus</td>
<td>60 (31.1)</td>
<td>24 (16.8)</td>
</tr>
<tr>
<td>Incarcerated hernia</td>
<td>44 (22.8)</td>
<td>44 (30.8)</td>
</tr>
<tr>
<td>Strangulation, intraperitoneal adhesions (postoperative or after typhoid fever, dysentery, tuberculosis)</td>
<td>42 (21.8)</td>
<td>42 (29.4)</td>
</tr>
<tr>
<td>Intussusception (ileocecal, descending into sigmoid colon)</td>
<td>24 (12.4)</td>
<td>23 (16.1)</td>
</tr>
<tr>
<td>Obstructionb</td>
<td>23 (11.9)</td>
<td>0</td>
</tr>
<tr>
<td>Colon cancer</td>
<td>NA</td>
<td>0</td>
</tr>
<tr>
<td>Neoplastic process (from neighborhood)</td>
<td>NA</td>
<td>4 (2.8)</td>
</tr>
<tr>
<td>Inflammatory infiltration</td>
<td>NA</td>
<td>0</td>
</tr>
<tr>
<td>Cicatric narrowing the lumen</td>
<td>NA</td>
<td>3 (2.1)</td>
</tr>
<tr>
<td>Gallstone ileus</td>
<td>NA</td>
<td>3 (2.1)</td>
</tr>
<tr>
<td>All</td>
<td>193 (100.0)</td>
<td>143 (100.0)</td>
</tr>
</tbody>
</table>

Abbreviations: LBO, large-bowel obstruction; NA, not applicable; SBO, small-bowel obstruction.

a Groups are described in the “Methods” section of the text. Percentages have been rounded and might not total 100.

b Numbers for SBO and LBO for the remaining causes total the numbers for obturation.
fiber diet has been deemed a major factor in the development of colon volvulus in the African population.\textsuperscript{16-18}

Also, etiological factors leading to intraperitoneal adhesions have changed. Bacterial infections caused most adhesions when Obalinski treated patients, whereas this cause is almost absent now. Today, intraperitoneal adhesions are associated only with previous laparotomies.

In the United States and Western Europe, the most common causes of SBO at present are intraperitoneal adhesions followed by incarcerated hernias.\textsuperscript{1,2,19} In our Polish population, the main cause of SBO remains incarcerated abdominal hernia followed by intraperitoneal adhesions. This phenomenon can be accounted for by several explanations. On the one hand, the findings can indicate too few people undergoing operation for abdominal hernias as scheduled; on the other hand, too many patients report to a hospital in an emergent state of incarceration. Second, although adhesions are a common cause of SBO, they do not produce bowel strangu-
lation that requires emergency surgery in every case, whereas hernias remain the most frequent cause of strangu-
lation in patients presenting with this condition.\textsuperscript{20} Third, in Poland as in some other countries from 1995 to 2010, there was a constant significant decrease in the number of patients with SBO caused by intraperitoneal adhesions.\textsuperscript{2,23,22} This phenomenon can be justified at least partially by the fact that laparoscopic techniques are more common in abdominal surgery. For instance, at our institution, approximately 70\% to 75\% of abdominal sur-
gery is performed using laparoscopy.

The presently observed 4-fold increase in LBO due to cancer can be accounted for, among other factors, by the fact that at the end of the 19th century, the mean life-
span was so short that most people did not reach the age when colon cancer develops. In addition, physicians lacked diagnostic tools, such as scopes and imaging. At that time, the first attempts at radiological diagnosis concerned mainly bone lesions (eg, fractures and disloca-
tions). Therefore, diagnoses were mainly based on an un-
clear clinical picture of bowel obstruction.

Our material also draws attention to the small per-
centage of patients (3.6\%) in whom LBO was caused by diverticulitis; a similar segment of patients was not iden-
tified in group 1. Age, sex, race, and geography all play specific roles in the development of diverticula.\textsuperscript{23} The merging of these factors changes the prevalence of di-
verticula and their manifestation. Prevalence of colonic diverticulosis is difficult to measure because most pa-
tients are asymptomatic. In addition, the number of pa-
tients with diverticulosis leading to LBO is unknown. Po-
land has a relatively low incidence of diverticulosis. In a recently published report, diverticula were found in 425 patients (14.16\%) in a group of 3001 asymptomatic men and women (mean age, 54.4 years) undergoing colono-
scopic examination.\textsuperscript{24}

Painter and Burkitt\textsuperscript{25} were the proponents of this theory, labeling diverticulosis a deficiency disease that could be avoided with dietary changes, namely, intake of high levels of fiber. However, the results of some studies in western populations comparing transit times and stool volumes in patients with and without diverticular disease have failed to show any significant differences.\textsuperscript{25-27}

In the second half of the 19th century, mechanical bowel obstruction resulted in a very high perioperative mortality rate. Among Obalinski’s cases, mortality was 54\% for the whole group, including 85\% for bowel obstruction caused by widespread adhesions, 77\% for cases caused by colon cancer, and 57\% for cases caused by incarcerated hernias with necrosis of the intestine.\textsuperscript{12,13} In reviewing these results, contemporary reality does not resemble the working conditions of our predecessors at the end of the 19th century. The 19th-century patients with bowel obstruction only saw the surgeon after a lengthy delay. Among Obalinski’s cases, the mean pe-
riod between the occurrence of acute symptoms of bowel obstruction and surgical intervention in the patients with incarcerated hernia exceeded 4.5 days.\textsuperscript{12,13} In those patients, the intestine became necrotic and peritonitis de-
veloped far more often. In contemporary incarcerated hernia material, the need to remove the intestine was 10-
fold less frequent compared with Obalinski’s cases (7.3\% and 76.0\% respectively). The delay also concerned pa-
tients with other types of bowel obstruction.

The comments in Obalinski’s clinical work reveal that a number of patients died in the postoperative period despite a technically proper performance of the procedure. Their presenting symptoms corresponded to oligovolemic or septic shock, unidentifiable at the
time, which could not be managed and was referred to as “collapse.”\textsuperscript{8,10}

Obalinski tried to maintain the principle still valid to-
day whereby the operating surgeon should always at-
tempt to identify a transitional point between the dis-
tended and collapsed bowel and then address the obstruc-
tion at that point. In Obalinski’s treatment strategy, the relevant surgical procedures used depended on the type of blockage (untwisting the bowel mesentery, cutting adhesions, freeing the loop, suturing the mesen-
tery, etc). Gangrenous intestine was resected with healthy ends and then rejoined axially with silk, using continu-
sus circular 2-layer suturing. Where the blockage could not be removed completely, bypass anastomosis or at-
tempted enterostomy or colostomy was performed prox-
ially but as close to the obstruction as possible.

When we compare the present opportunities and those of the past, Obalinski must be regarded as a precursor of contemporary surgery within the scope of surgical treat-
ment of acute mechanical bowel obstruction in Poland and Central Europe.

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Mechanical Bowel Obstruction

A Tale of 2 Eras

Drozd\textsuperscript{1} and Budzynski\textsuperscript{1} offer a comparative study of mechanical bowel obstruction at the same institution in Poland during 2 periods, 1868 through 1898 and 2000 through 2003. The information provides insight into medicine and surgery in the distant past. Differences in the etiology of obstruction in the 2 periods can be explained in part by multiple factors. First, public health in the 19th century was poor and is tantamount to a health care institution.

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