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OBESITY IN THE CHILDREN POPULATION AND ROBOTIC SURGERY: INFLUENCE ON THE COURSE OF THE PROCEDURE AND PROGNOSIS, NEW POSSIBILITIES IN BARIATRIC SURGERY - LITERATURE REVIEW

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ABSTRACT

Obesity is a disease that is becoming increasingly common among children and is associated with a number of complications such as hypertension, the development of type 2 diabetes, non-alcoholic fatty liver disease and respiratory disorders. One of the methods of treating both obesity and its complications are surgical operations, e.g. bariatric surgery, among which surgical robots are increasingly used tools. Robotic surgery is similarly effective to standard techniques and is often associated with a shorter hospital stay for overweight children, making it an increasingly common procedure; however, its costs remain significant. This article focuses on the use of robotic surgery in the treatment of obesity and its complications in children. We also discuss the advantages and limitations of this type of procedure.

KEYWORDS

Robotic Surgery, Obesity, Children, Pediatrics, Adolescence, Bariatric Surgery

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Introduction

In the modern world, in developed countries we often overlook the influence of food on history. In the past, before the mass production of it, advanced techniques, modern machines and fertilizers, feeding an entire family was not something certain, especially for lower social classes. In the Inca Empire meat and corn were foods reserved almost only for the elite, on the eve of the French Revolution the height of social inequalities could have been easily seen by comparing feasting aristocrats and starving lower classes, during 20th century it was not uncommon for only the breadwinner to eat meat daily, in third world countries till this day starvation is a serious concern. Even for higher ups in hierarchy in the times of war, natural catastrophes, blockades and plagues, famine was not unfamiliar - hence the difference of height between us and our ancestors - a phenomenon directly linked to the level of nutrition during childhood.

What is also important, as basic human need, availability of food was always a concern for past and modern rulers. Since ancient Rome we know that one has to grant bread and circuses to rule successfully, during the French Revolution lower classes have been seeing the difference mentioned earlier as well, in the 20th century first cracks in the Eastern Block were oftentimes not caused by political tensions but rather by starving workers.

To summarise - creating surplus food - food cheap and affordable for everyone was the goal both for individuals and for governments. And in the present day more and more people indeed avoid starvation and for most countries one of priority goals is to feed all their people.

But this noble goal has brought a new crisis present more and more in the medical and non-medical world - the spread of obesity. What is even worse, one of the groups in which obesity rose the fastest has been the pediatric population. According to the National Health and Nutrition Examination Survey, based on data collected from 2017 to 2018, 21.2% of youth ages 12–19 years are obese. What is worse, that is an increase of 6.4 percentage points in roughly 20 years with a high rate of severe obesity (i.e. Class 2 obesity or higher) - which only shows how rapidly this issue is expanding. [1]

The challenge for modern pediatrics is both to reverse this trend and to cure children already overweight, preventing future complications for them. Fortunately technological progress gives us new tools improving many fields of medicine - one of them being robotic surgery. And about the correlation between it and obesity we wanted to talk about today.

Methodology

A qualitative synthesis of the data focusing on robotic surgery and obesity in children from March to July 2026 was performed using the PubMed database. This literature review utilized publications related to the use of robotic surgery in the treatment of weight disorders in children and their potential complications over the years 2002–2026. The literature selection was guided by specific keywords and medical subject headings (MeSH terms) such as “robotic surgery”, “obesity”, “children”, “pediatrics”, “adolescence”, “bariatric surgery”. The selection criteria for the papers were publication before May 2026 in English and peer-reviewed original research articles. Papers that were not available in their entirety, were published in a language other than English, or were editors' notes, commentaries or conference abstracts were not considered. The available works were then assessed based on the above-mentioned criteria.

Results

In this literature review, the aim was to introduce the topic of robotic surgery related to obesity in the children population, to look at the progress in it and to discuss the future of this field.

We compared publications from over 20 years and identified the advantages and disadvantages of robotic surgery, and based on them we formulated predictions about the future of this field.

History

First attempts in implementing robotic surgery for pediatric patients were made when even its adult counterpart was fresh. In 2002 the first reported series of pediatric robotic surgery cases was published. [2] Operators used the da Vinci robot and in summary there were 14 patients described - 11 with uncontrolled symptoms of regurgitation and pulmonary infection treated with robotically assisted fundoplication, 2 with symptomatic cholelithiasis treated with robotically assisted cholecystectomy and 1 with gonadal tumor treated with bilateral salpingo-oophorectomy. The conclusion of the report was that robotic pediatric surgery shared the benefits with its adult version (lowering encumbrance of the performing surgeon, better field of view and tool control compared to laparoscopy, etc.) however to its drawbacks, from which the biggest one is the cost of the procedure, it added the issue of the size of the tools. [3] And since then those 2 factors - reducing the costs and miniaturisation - are the greatest rooms for improvement needed for robotic surgery to be used wider in the pediatric population.

Modern procedures

In the field of bariatrics in the pediatric population, usage of robotic assisted procedures has also been introduced a respectable amount of time ago. The first case report from 2012 describes a morbidly obese 13-year old girl in whose treatment robotic-assisted gastroplication was used. The results were desirable, with the inclusion of other forms of therapy by a multi-disciplinary team 3 weeks post surgery, a significant improvement for the patient was achieved. Despite differences in the field, the conclusions of the case report did not vary very much from cases described above, as pros and cons of usage of the robotic surgery were more or less the same. [4] However, due to the fact that in general bariatric surgical procedures in this age group should be the last resort to be considered, as dietician, endocrine, psychiatrist, etc. interventions should be the primary method of treatment, not that many procedures have been executed. That is why, despite not being technically that new branch of medicine, our experiences with it are still very limited.

The cost and time

As can be seen, the conclusions of these studies are largely consistent, particularly regarding the main disadvantages of robotic surgery. In 2016, a very interesting study was published that focused on quantifying the scale of these challenges. The researchers conducted a retrospective analysis of two groups of adolescents, each consisting of 14 patients, matched with respect to BMI, demographic characteristics, and comorbidities. One group underwent **robotic-assisted laparoscopic sleeve gastrectomy (RLSG)**, while the other underwent **conventional laparoscopic sleeve gastrectomy (LSG)**. The investigators compared 30-day postoperative outcomes, procedure duration, length of hospital stay, and treatment-related costs between the two groups.

The results demonstrated no significant differences in clinical outcomes or complication rates. However, laparoscopic procedures were completed more quickly, with a mean operative time of 100 minutes compared to 132 minutes in the robotic-assisted group (p = 0.0002). More importantly, laparoscopic surgery was associated with significantly lower costs, averaging **$49,498 versus $56,646** for robotic-assisted procedures (p = 0.0366). The only parameter favoring robotic-assisted laparoscopic sleeve gastrectomy was the length of hospital stay: patients in the robotic-assisted group remained hospitalized for an average of 69.6 hours, compared with 75.9 hours in the laparoscopic group (p = 0.0094) [5].

One may question whether the difference in operative times would have been less pronounced if robotic procedures had been performed more frequently and surgeons had possessed equivalent levels of experience with both techniques. Nevertheless, these findings were not particularly encouraging, a point that will be addressed further in the discussion.

As one of the most important bariatric procedures, **sleeve gastrectomy** has also been the subject of more recent comparisons between robotic and conventional approaches. In one study, 129 patients were analyzed, of whom 45 underwent robotic-assisted surgery and 84 underwent laparoscopic surgery. The two groups were comparable in terms of age, sex, ethnicity, and mean BMI. Similar to the earlier study, operative time was longer for the robotic approach, averaging **90.1 minutes compared with 67.3 minutes** for the laparoscopic technique [16].

Use in the treatment of specific diseases

Another obesity-related condition for which robotic surgery is increasingly being utilized is **gallbladder disease**. The growing prevalence of obesity among children has led to an increase in cholesterol gallstone formation, enhanced cholesterol secretion into bile, biliary stasis within the gallbladder, and hormonal disturbances, all of which contribute to a substantial rise in the incidence of gallbladder disorders. Laparoscopic surgery remains the gold standard for treatment; however, robotic procedures have also gained a degree of popularity. A publication based on a database of 102 patients aged 15–18 years who underwent **single-incision robotic cholecystectomies** and one **single-port subtotal cholecystectomy** between 2015 and 2021 demonstrated that the robotic approach is both safe and feasible in the pediatric population as well [12].

In another analysis comparing **laparoscopic cholecystectomy** with **robot-assisted cholecystectomy**, based on 196 laparoscopic procedures and 224 robot-assisted procedures performed between 2017 and 2024 in patients younger than 19 years of age, the effectiveness of both approaches in the pediatric population was found to be comparable. However, among obese patients, the robotic approach emerged as the preferred technique. Both groups demonstrated similar rates of postoperative complications and hospital readmissions. It should be noted, however, that the robotic procedure required, on average, an additional 11 minutes compared with standard laparoscopy [13].

Another obesity-related condition is **lingual tonsil hypertrophy**. Robotic surgery has also been increasingly employed in the treatment of **obstructive sleep apnea (OSA)** associated with this disorder. A retrospective analysis of 56 pediatric patients who underwent **transoral robotic surgery (TORS)** for lingual tonsillectomy between 2015 and 2024 demonstrated a statistically significant reduction in the frequency of apneic and hypopneic episodes compared with conventional surgical techniques. The study further indicated that robotic tonsillectomy was equally effective in both overweight and normal-weight patients, whereas standard surgical procedures tend to yield better outcomes in patients with normal body weight. These findings highlight the potential of robotic surgery as a particularly promising technique for obese pediatric patients, who are inherently at greater risk of perioperative complications and adverse outcomes [14].

Among the conditions for which robotic surgery offers promising potential for improving treatment outcomes is **adrenocorticotropic hormone (ACTH)-independent Cushing's syndrome**, a very rare but potentially life-threatening disorder. In cases where the disease is associated with **bilateral nodular adrenal hyperplasia**, **synchronous bilateral adrenalectomy** is an effective surgical intervention for correcting hypercortisolemia. When performed using a robotic platform, this procedure can be successfully carried out even in infants. In the largest published cohort of pediatric patients undergoing bilateral adrenalectomy for Cushing's syndrome, conversion to open laparotomy was required in only one case, due to significant adhesions between the right adrenal gland and the inferior vena cava.

Published outcomes also suggest that the robotic approach may facilitate a faster postoperative recovery. Specifically, the time to resumption of oral feeding and return of bowel function was reported to be approximately **1.6 and 2.5 postoperative days**, respectively, compared with **2.5 and 3 days** following non-robotic surgery. In such a young patient population, these differences may represent an important factor influencing the choice of surgical technique.

It should be emphasized, however, that because of the rarity of the condition, the study included only **10 children**, of whom **6 underwent robotic surgery**. Consequently, further observations involving larger pediatric cohorts will be necessary before this approach can be more broadly adopted in clinical practice [15]

Difficulties in the data collection

It should also be remembered that, due to the unique characteristics of the pediatric population, some of the clinical scenarios in which robotic surgery has a substantial impact on operative outcomes and prognosis are simply not applicable to children. For obvious reasons, **robot-assisted prostatectomy**, although performed in thousands of adult patients, represents an exceptional rarity in pediatric practice [11].

Furthermore, even in the case of conditions that exhibit multiple incidence peaks across the lifespan, the available literature tends to focus primarily on adult patients or, at the very least, does not distinguish specific challenges and solutions relevant to the pediatric population. One example is **abdominal hernia**, for which robotic surgery has demonstrated documented advantages over conventional laparoscopy. These procedure-specific benefits include the ability to place surgical mesh in a variety of extraperitoneal positions within the abdominal wall while maintaining low morbidity. The condition itself is characterized by two incidence peaks—one occurring in very young children, typically before the age of five, and another among older adults, usually between 75 and 80 years of age. However, even comprehensive reviews of robotic hernia repair rarely address the issue from a pediatric perspective. Consequently, the applicability of their conclusions to pediatric patients depends largely on the individual circumstances of each case and is likely to be most relevant for adolescents whose anatomical and physiological characteristics more closely resemble those of adults—a group in which such cases remain relatively uncommon [6,7].

The influence of obesity on the course of the procedure

Regarding the impact of obesity on the effectiveness of robotic procedures themselves, the effects will usually depend on the type of procedure. In the case of robotic-assisted vertical sleeve gastrectomy (VSG), interesting results were described in a retrospective analysis, where 115 cases were divided into two groups, differentiating them depending on BMI - the first group BMI<50 kg/m2 (64 patients), the second BMI≥50 kg/m2 (51 patients). Otherwise, the groups were similar in terms of age and ethnicity, differing only in a slightly higher percentage of male patients in the second group (4.7% vs. 27.5%). The study's conclusions may be surprising, but at the same time they may give hope to patients with a very significant degree of obesity, as no differences were observed between the groups during the procedure and in the early postoperative period. Of course, the percentage of adverse events during the entire hospitalization was still higher in the group of more obese children. [1]

Discussion

The effectiveness of bariatric surgery itself has been well documented—patients who undergo these procedures are significantly more likely to achieve normalization of dyslipidemia, hypertension, hyperinsulinemia, diabetes mellitus, and elevated levels of high-sensitivity C-reactive protein (hs-CRP) [8]. The development of robotic surgery has also been remarkable. For example, in the United Kingdom, 3,622 robotic procedures were performed in 2014, compared with 36,209 in 2024 [9]. It should also be noted that approximately 60% of robotic surgical system installations are located in the United States, where comprehensive data on procedure volumes are lacking; nevertheless, this fact suggests the substantial scale at which such surgeries are being performed [10]. All of this offers hope that costs will decrease, miniaturization will continue to advance, and the full potential of this field of medicine will be realized in the future.

However, it should not be forgotten that, at present, the cost-effectiveness of these procedures—particularly when compared with conventional laparoscopy—remains a significant barrier. This is especially relevant in lower-income countries, where it is reasonable to question whether investment in less expensive alternatives might be a better use of limited healthcare resources. It is difficult to determine the exact difference in costs, due to the scarcity of statistics, and those available are difficult to compare - it is up to researchers whether they will include only materials or the entire hospitalisation in the costs, prices may vary depending on the country, etc. Based on the data in the articles cited here, the costs of robotic surgery are between 15% and 50% higher than the costs of laparoscopy, which represents a wide range of results. However, even assuming an optimistic outcome for the robotic method, the difference compared to more traditional methods is still large. Therefore, until this cost difference is significantly reduced, the widespread adoption of robotic surgical systems will continue to face considerable challenges.

Conclusions

Despite over 20 years of development, robotic surgery in pediatrics still faces problems similar to those from its debut. The price of procedures and their relatively small number - which makes it difficult to draw conclusions and improve procedures - are still a barrier that prevents the replacement of traditional methods by robots from being on the horizon. However, looking from a slightly more optimistic perspective, this field of medicine is developing more and more, it is already shortening the average length of a patient's stay in hospital and in an increasing number of procedures it is becoming possible and safe even for the youngest patients.

To sum up - robotic surgery is admittedly expensive, but a powerful tool that already provides doctors with an alternative, and its development still brings hope for expanding the horizons of surgical medicine.

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