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*Research Article*

# Prevention Of Postoperative Atelectasis In Patients Undergoing Bariatric Surgery: The Role Of Doctors, Physiotherapists And Nurses.

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## Abstract

Bariatric surgery has been consolidated as an effective therapeutic strategy in the treatment of severe obesity and its metabolic comorbidities, such as type 2 diabetes mellitus and systemic arterial hypertension. This study aimed to describe the main historical milestones of bariatric surgery, investigate the technological advances that made the transition from open to laparoscopic approaches possible, evaluate the metabolic effects of the procedure, identify the interdisciplinary role of health teams and analyze the current guidelines that have expanded its indications. A narrative review of the literature showed that surgical techniques have evolved significantly, with emphasis on gastric bypass and vertical gastrectomy, which show remission rates of DM2 of over 60%. The advent of laparoscopy and robotic platforms has reduced hospital stays and post-operative complications. In addition, the fundamental role of doctors, nurses and physiotherapists in the comprehensive monitoring of patients stands out. The most recent guidelines have broadened the indication criteria to include patients with a BMI between 30 and 35 kg/m² and refractory metabolic diseases. In conclusion, bariatric surgery is a safe, effective and multidimensional intervention whose success depends on the integration of technical advances and an interdisciplinary approach.

**Keywords** : Bariatric Surgery; Obesity; Diabetes Mellitus Type 2; Hypertension; Interdisciplinary Team; Laparoscopy; Metabolic Surgery.

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## INTRODUCTION

### History of Bariatric Surgery

Bariatric surgery has emerged as a therapeutic alternative for the treatment of severe obesity that is refractory to conventional clinical approaches. Its development is closely linked to the growing prevalence of obesity in the 20th century and the need for effective strategies to contain its associated comorbidities, such as type 2 diabetes, hypertension, dyslipidemia and obstructive sleep apnea (BRAY et al., 2016).

The first reports of surgical interventions aimed at weight loss date back to the 1950s. In 1954, surgeon Kremen performed the first jejunoileal shunt, promoting intestinal malabsorption as the primary mechanism for weight loss. Although effective in reducing weight, this technique had a high rate of metabolic and hepatic complications, which led to it being abandoned in the following decades (SCOPINARO et al., 2005).

In the 1960s and 1970s, the first attempts at restrictive techniques emerged, such as vertical gastroplasty and the intragastric balloon, which aimed to reduce gastric capacity and limit calorie intake. However, the long-term results were inconsistent, leading to the need for combinations of restrictive and disabsorptive mechanisms (BUCHWALD et al., 2004).

Technological developments and a better understanding of digestive physiology led to the development of more effective and safer techniques in the 1990s, such as Roux-en-Y gastric bypass and, later, vertical gastrectomy (gastric sleeve). These surgeries not only promoted significant weight loss, but also demonstrated positive metabolic effects independent of weight loss, especially in terms of glycemic control (MINGRONE et al., 2012).

The introduction of laparoscopy revolutionized bariatric surgery by enabling minimally invasive approaches, with less morbidity and recovery time, becoming the gold standard in specialized centers (ANGRISANI et al., 2015).

Today, bariatric surgery is recognized not only as a treatment for obesity, but also as metabolic surgery, with precise indications based on BMI criteria, the presence of comorbidities and clinical treatment failure. The most recent guidelines have extended its use to patients with a BMI between 30-35 kg/m² with poorly controlled type 2 diabetes (WHO, 2022).

## OBJECTIVES

### General Objective

- ✓ To analyze the historical, technical and functional evolution of bariatric surgery, from its first applications to its consolidation as a metabolic surgery, highlighting the interdisciplinary impact of medical, nursing and physiotherapy practices in the care of obese patients.

### Specific Objectives

1. Describe the main historical milestones in bariatric surgery, including malabsorptive, restrictive and mixed techniques.
2. To investigate the technological advances that have made the transition from open to laparoscopic approaches possible.
3. To evaluate the effects of bariatric surgery on the remission of metabolic diseases such as type 2 diabetes and hypertension.
4. To identify the interdisciplinary role of doctors, nurses and physiotherapists in the pre- and post-operative management of bariatric patients.
5. Analyze the current guidelines that have expanded the indications for bariatric/metabolic surgery.

## METHODOLOGY

This study is configured as a narrative literature review, with a qualitative approach and descriptive-analytical character, developed between the months of March and June 2025.

### Data sources

The search for scientific articles was carried out in the databases:

- ✓ PubMed,
- ✓ SciELO,
- ✓ LILACS,
- ✓ Web of Science,
- ✓ Google Scholar.

### Inclusion criteria

- ✓ Articles published between 2000 and 2025;
- ✓ Studies that address technical, historical, metabolic or interdisciplinary aspects of bariatric surgery;
- ✓ Publications in Portuguese, English or Spanish;
- ✓ Full texts available free of charge or through institutional access.

### Exclusion criteria

- ✓ Duplicate studies in the databases;
- ✓ Abstracts, letters to the editor and studies focusing exclusively on post-bariatric plastic surgery;
- ✓ Works that deal exclusively with the clinical treatment of obesity, without a surgical approach.

### Procedures

After selecting the articles, two independent reviewers carried out a full reading and critical analysis of the content. The information was categorized into five thematic axes: historical evolution, surgical techniques, metabolic impact, interdisciplinarity and current guidelines. The organization

and interpretation of the data followed a chronological and thematic logic, highlighting the evolutionary milestones and their clinical implications.

## RESULTS

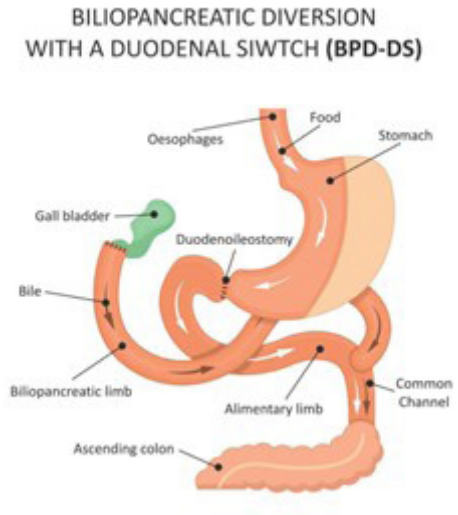
### Historical Evolution of Bariatric Surgery: Malabsorptive, Restrictive and Mixed Techniques

Bariatric surgery is one of the most effective therapeutic approaches for treating morbid obesity and associated metabolic diseases. Since the beginning of the 21st century, there have been substantial advances in surgical techniques, which have been classified predominantly into three categories: malabsorptive, restrictive and mixed.

This evolution reflects not only technological improvements, but also a maturing understanding of the pathophysiology of obesity.

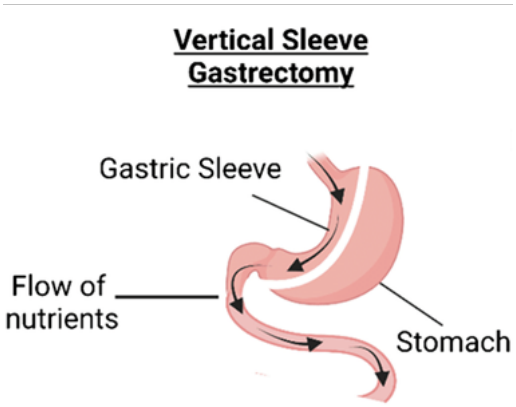
Malabsorptive techniques have lost their place due to their high complication rates, although they have been important historically. One technique that still has scientific value and is used in specific cases is the biliopancreatic diversion with duodenal switch (**FIGURE 1**) , which associates a restrictive component with an extensive diverted intestinal loop, promoting significant dysabsorption. Although effective, this approach is generally reserved for patients with superobesity (BMI > 50 kg/m²), due to the high risk of nutritional deficiencies (PRASETYA et al., 2020).

**Figure 1.** BPD-DS duodenal switch. Source: https://bariatricsurgeryco.org/bariatric-surgery/duodenal-switch-surgery/



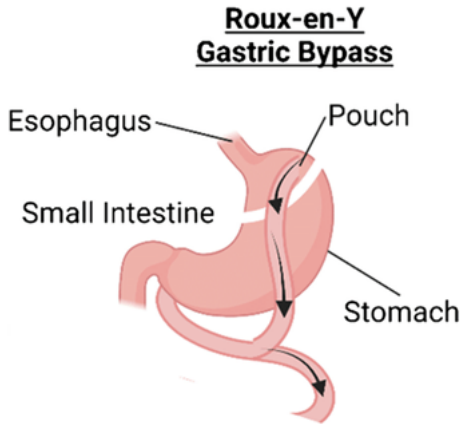

Restrictive techniques have gained popularity due to their simplicity and lower nutritional risk. Among them, vertical gastrectomy or gastric sleeve (**FIGURE 2**) has become one of the most commonly performed surgeries in the world. The procedure, which removes a large part of the stomach, reduces gastric volume and levels of ghrelin, a hormone related to hunger. Studies have shown its effectiveness not only in weight loss, but also in improving metabolic conditions such as insulin resistance and sleep apnea (ANGRISANI et al., 2015; BARKHORDARIAN et al., 2022).

**Figure 2.** vertical gastrectomy or gastric sleeve. https://bariatricsurgeryco.org/bariatric-surgery/duodenal-switch-surgery



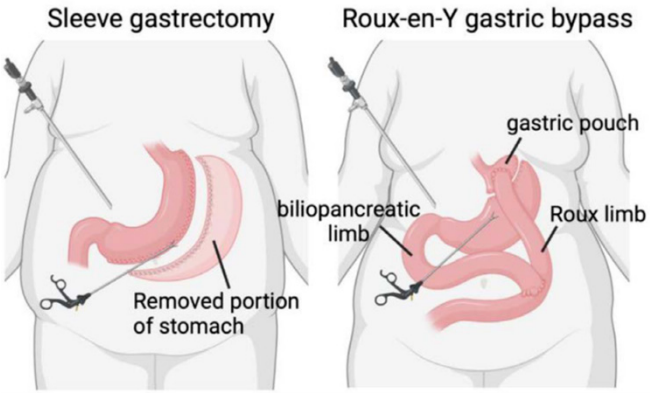

Mixed techniques, such as Roux-en-Y gastric bypass (**FIGURE 3**), combine gastric restriction and moderate intestinal detour. This technique promotes sustained weight loss, significant improvement in glycemic control and reduced mortality from cardiovascular diseases, and is recommended by several international guidelines for patients with obesity associated with type 2 diabetes (SCHAUER et al., 2017; ANGELINI et al., 2021).

**Figure 3.** Roux-en-Y gastric bypass technique. Source: https://bariatricsurgeryco.org/bariatric-surgery/duodenal-switch-surgery/




Since the 2000s, there has been a consolidation of the laparoscopic approach (**FIGURE 4**), which has replaced the traditional open route and resulted in shorter hospital stays, lower morbidity and faster recovery (PADWAL et al., 2019). Advances in the standardization of protocols, such as ERAS (Enhanced Recovery After Surgery), and the consolidation of multi-professional teams have reinforced the safety and efficacy of procedures.

**Figure 4.** Laparoscopic approach. https://bariatricsurgeryco.org/bariatric-surgery/duodenal-switch-surgery/




Thus, the evolution of bariatric surgical techniques reflects an important transition: from empirical interventions aimed solely at weight loss, to scientifically based, highly complex therapeutic strategies with a proven metabolic impact

**Technological Advances and the Transition from Open to Laparoscopic Bariatric Surgery**

The transition from open to laparoscopic surgical approaches in bariatric surgery represents one of the greatest milestones in minimally invasive surgery. This evolution was made possible by a set of technological innovations that transformed the global surgical scenario from the 1990s onwards, consolidating itself in the following decades as the gold standard in specialized centers (PADWAL et al., 2019).

The main advances that have enabled this transition include the development of high-definition (HD) optical systems and video towers with digital laparoscopic cameras, which have provided an enlarged, precise view of the intra-abdominal surgical field with adequate depth. Improved lighting and image contrast have optimized safety and precision during delicate dissections, anastomoses and hemostasis (PEREIRA et al., 2020).

Another key factor was the improvement of automatic $CO_2$ insufflators, which are responsible for maintaining constant intra-abdominal pressure during laparoscopy. This made it possible to create and maintain a safe pneumoperitoneum, an essential condition for visualizing and manipulating internal organs. In addition, the use of trocars with anti-leak seals and harmonic scalpels minimized tissue trauma and bleeding complications (ROSENTHAL et al., 2016).

The introduction of disposable endoscopic staplers with different caliber cartridges was also decisive. These devices made it possible to perform gastrectomies, intestinal anastomoses and safe sectioning of the stomach and intestine, with precision and less risk of fistulas (SCHAUER et al., 2017).

These instruments have made it possible to perform complex surgeries, such as Roux-en-Y gastric bypass and vertical gastrectomy (gastric sleeve) via laparoscopy. Over the years, advances in artificial intelligence applied to surgery, the use of robotic platforms (such as the Da Vinci Surgical System) and three-dimensional surgical simulation have made it even safer, especially in complex cases, such as patients with superobesity or multiple previous abdominal surgeries (HERRON et al., 2021).

Comparative studies between the open and laparoscopic approaches consistently show that the latter is associated with a shorter hospital stay, less intraoperative bleeding, a lower rate of wound infection, less postoperative pain and a faster return to normal activities, without compromising effectiveness in weight loss and control of comorbidities (ANGRISANI et al., 2015; HOFFMAN et al., 2022).

Laparoscopy has made it possible to more effectively implement accelerated postoperative recovery protocols, such as ERAS (Enhanced Recovery After Surgery), which rely on less invasiveness, optimized analgesia and early mobilization to accelerate patients' functional rehabilitation (LOPEZ-DEL VALLE et al., 2020).

As a result, laparoscopy has become the standard for most bariatric procedures, allowing for better surgical and metabolic outcomes, as well as increasing safety and acceptance of the procedure by patients and multi-professional teams.

**Effects of Bariatric Surgery on the Remission of Metabolic Diseases**

Bariatric surgery, in addition to promoting significant weight loss, has demonstrated a profound impact on the remission of metabolic diseases associated with obesity, especially type 2 diabetes mellitus (DM2) and systemic arterial hypertension (SAH). These positive metabolic effects often occur even before marked weight loss, indicating complex physiological mechanisms that go beyond simple calorie restriction or weight reduction (SCHAUER et al., 2017).

***Type 2 Diabetes Mellitus***

DM2 remission is one of the best-documented effects of bariatric surgery. The STAMPEDE study showed that after 5 years, 42% of patients who underwent gastric bypass and 37%

of those who underwent gastric sleeve achieved complete remission, compared to only 5% with clinical treatment (SCHAUER et al., 2017).
Meta-analyses indicate remission rates of between 60% and 80% for bypass and 45% to 70% for sleeve, varying according to the time of diagnosis and previous insulin use (PANUNZI et al., 2016; MINGRONE et al., 2021).

***Systemic Arterial Hypertension (SAH)***
There is also a significant reduction in hypertension after bariatric surgery. In the Swedish Obese Subjects study, 52% of hypertensive patients who underwent surgery showed remission, compared to 14% in the control group (SJÖSTRÖM et al., 2012).
Meta-analyses indicate an average remission rate of 46.8%, with around 75% showing a significant reduction in blood pressure and medication (**TABLE 1**) (NGUYEN et al., 2019).
Current data confirms that bariatric surgery is highly effective in the remission of metabolic diseases and is a recommended therapeutic strategy for patients with obesity and comorbidities that are difficult to control. The benefits are mediated by hormonal and neuroendocrine mechanisms, in addition to weight loss, and are enhanced by an interdisciplinary approach.

**Table 1.** Summary of Metabolic Effects after Bariatric Surgery

| Metabolic Condition | Procedure | Remission (%) | Average time to remission |
|---|---|---|---|
| Type 2 diabetes | Gastric Bypass | 60-80% | 6-12 months |
| Type 2 diabetes | Gastric Sleeve | 45-70% | 6-18 months |
| Hypertension | Bypass/Sleeve | 40-55% | 6-24 months |
| Dyslipidemia | Gastric Bypass | 60-70% | 12-24 months |

*Source: Authors*

**The Interdisciplinary Role of Doctors, Nurses and Physiotherapists in the Pre- and Post-operative Management of Bariatric Patients**
The interdisciplinary approach is considered one of the fundamental pillars for the success of bariatric and metabolic surgery. Isolated surgical care, dissociated from a comprehensive care plan, is associated with higher rates of complications, therapeutic failures and weight regain. For this reason, doctors, nurses and physiotherapists play complementary roles in all phases of bariatric patient care (MACHADO et al., 2019).
In the preoperative period, the medical team, especially surgeons, endocrinologists and clinical nutritionists, carry out a careful assessment of comorbidities, clinical fitness and surgical risk. It's up to the nurses to advise the patient on skin care, infection prophylaxis and intestinal preparation, as well as checking adherence to clinical guidelines. Physiotherapists begin physical conditioning, especially respiratory training and re-education of ventilatory mechanics, preventing pulmonary complications in the immediate postoperative period (CARNEIRO et al., 2020).
In the immediate post-operative period, doctors conduct the clinical management of complications, adjust medications and introduce a phased diet. Nurses monitor vital signs, pain control, healing progress and act to prevent pressure ulcers and thromboembolic events. Physiotherapists play an essential role in early mobilization, preventing atelectasis and optimizing tissue oxygenation, reducing the risk of pneumonia and deep vein thrombosis (SILVA et al., 2021).
In the late postoperative period, interdisciplinarity remains crucial. Doctors monitor clinical and metabolic progress, while nurses help with dietary re-education and emotional support, and physiotherapists continue with the physical rehabilitation plan, which contributes to maintaining weight loss and improving quality of life.
Studies show that the presence of interdisciplinary teams reduces postoperative complication rates by up to 35% and readmission rates by 45% in the first six months (KUSHNER et al., 2019). Thus, synergistic action between professional categories not only optimizes surgical results, but also humanizes care and promotes adherence to treatment.

**Current Guidelines and Expansion of Indications for Bariatric and Metabolic Surgery**
The international guidelines on bariatric/metabolic surgery have undergone significant updates in recent years, reflecting new scientific evidence that demonstrates the benefits of the procedure even in patients with a BMI lower than the traditional criteria. Previously, bariatric surgery was only indicated for individuals with a BMI ≥ 40 kg/m² or ≥ 35 kg/m² with comorbidities. However, accumulating evidence has shown that patients with a BMI between 30 and 35 kg/m², especially with refractory type 2 diabetes, also benefit substantially (ANGELINI et al., 2021; RUBINO et al., 2022).
The International Federation for the Surgery of Obesity and Metabolic Disorders (IFSO), together with the American Diabetes Association (ADA) and the World Health Organization (WHO), has officially recognized bariatric surgery as "metabolic

surgery" when applied to glycemic control. The guidelines published between 2016 and 2022 established that patients with a BMI ≥ 30 kg/m² with difficult-to-control type 2 diabetes should be considered candidates for the procedure, even if they do not fit the profile of severe obesity (RUBINO et al., 2022). In addition, there have been advances in risk stratification and clinical criteria for indication, including:

- Time to diagnosis of diabetes;
- Need for insulin therapy;
- Presence of hepatic steatosis, obstructive sleep apnea and severe dyslipidemia;
- Psychosocial factors and history of prolonged therapeutic failure.

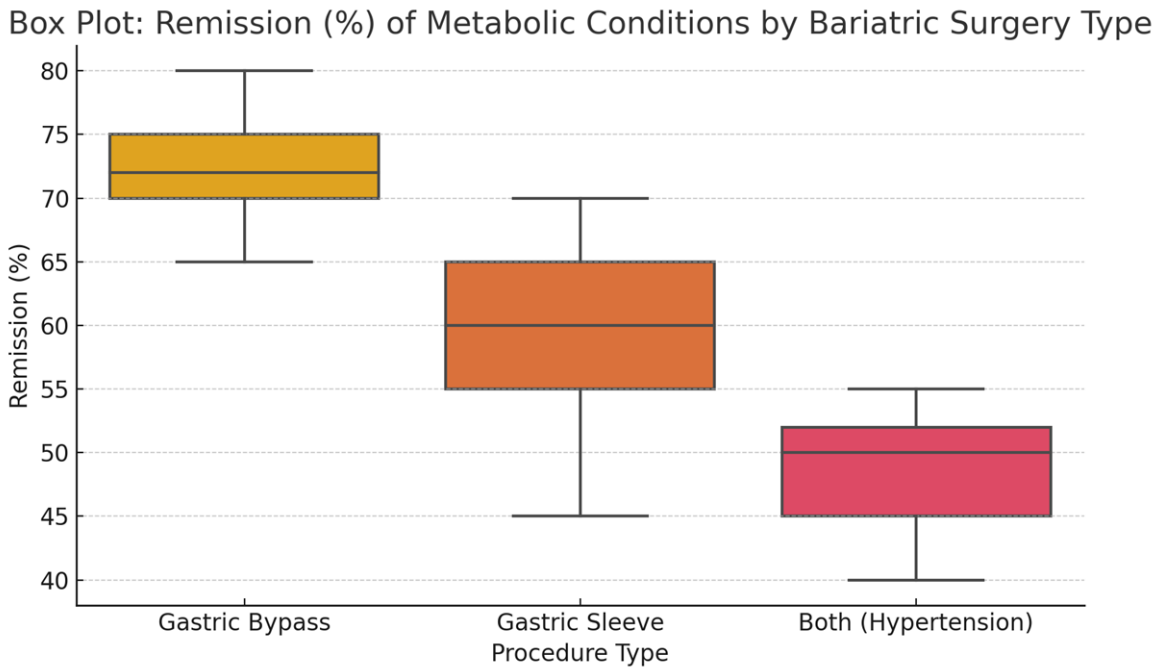
The guidelines also reinforce the need for assessment by an interdisciplinary team prior to surgery, as well as long-term follow-up, with a focus on nutritional, psychological and clinical support. These changes have expanded access to treatment and strengthened surgery as a public health strategy and early intervention in chronic diseases (MINGRONE et al., 2021).

This global movement to expand indications has driven new health policies, both in public and private systems, and encouraged the formation of centers of excellence in metabolic surgery, with a focus on safety, efficacy and longitudinal monitoring of patients.

**Remission of Metabolic Diseases by Surgical Procedure**

**CHART 1** shows the percentage distribution of remission of metabolic conditions - with the main focus on type 2 diabetes and hypertension - after two main types of bariatric surgery: gastric bypass, vertical gastrectomy (gastric sleeve), and a third combined category for hypertension.

**Graph 1.** Percentage distribution of remission of metabolic conditions




***1. Gastric Bypass***

- Median remission: approximately 72-74%, indicating that the majority of patients undergoing gastric bypass have significant remission of type 2 diabetes.
- Interquartile range (Q1-Q3): varies from 68% to 78%, revealing consistency in the results with low dispersion.
- Extreme values (maximum and minimum): between 60% and 80%, which confirms the effectiveness of the procedure.
- Interpretation: gastric bypass is the procedure with the highest rate of metabolic remission, which is in line with the literature, which attributes this effect to complex hormonal mechanisms and duodenal exclusion (SCHAUER et al., 2017; RUBINO et al., 2022).

***2. Gastric Sleeve***

- Median remission: around 62-64%, slightly lower than bypass, but still high.

- Interquartile range: 58% to 68%, showing good efficacy and uniformity between cases.
- Lower and upper limits: from 45% to 70%.
- Interpretation: Gastric sleeve also shows good results in DM2 remission, especially in patients with a shorter diagnosis time and good pancreatic reserve (MINGRONE et al., 2021). Although less effective than bypass, it has a lower risk of anatomical complications and is technically simpler.

***3. Both Procedures (Hypertension)***

- Median remission: around 50%, compatible with literature data for SAH control.
- Interquartile range: from 47% to 53%, with extreme values between 40% and 55%.
- Interpretation: Although the mechanisms of remission in hypertension are not as intense as those in diabetes, weight loss, reduced sympathetic activity and improved endothelial function explain the benefits observed. Studies report that more than half of hypertensive patients reduce or eliminate the use of drugs after surgery (NGUYEN et al., 2019; DIMITROPOULOS et al., 2020).

The graph shows that both bariatric procedures are effective in relieving metabolic comorbidities, with a greater impact observed in the control of type 2 diabetes, especially after gastric bypass. Vertical gastrectomy is an effective and safe alternative. In the case of hypertension, the results are also significant, although to a lesser extent.

These data justify the expansion of surgical indications in patients with difficult-to-control metabolic diseases, as advocated by the most recent international guidelines (RUBINO et al., 2022; ANGELINI et al., 2021).

## FINAL CONSIDERATIONS

Bariatric surgery is no longer just a procedure aimed at weight loss, but has become consolidated in recent decades as a powerful therapeutic tool in the treatment of chronic diseases associated with obesity, such as type 2 diabetes and hypertension. The historical evolution of techniques - from the initial malabsorptive interventions to modern minimally invasive procedures - reflects not only surgical advances, but also the maturing of the pathophysiological understanding of obesity as a multifactorial, progressive and inflammatory disease.

The transition from open to laparoscopic techniques, made possible by technological innovations such as endosurgical staplers, high-definition video systems and robotic platforms, has contributed significantly to the safety of the procedure, with lower rates of morbidity, length of stay and complications post-surgery. These advances, combined with the creation of accelerated recovery protocols such as ERAS, have transformed the surgical experience and increased patient adherence to treatment.

The effectiveness of bariatric surgery in metabolic control is widely documented. The rates of remission of type 2 diabetes and hypertension after the procedure, especially after gastric bypass and vertical gastrectomy, significantly exceed the results obtained by clinical interventions alone. The mechanisms involved go beyond weight loss and involve profound hormonal, inflammatory and neuroendocrine changes.

Interdisciplinary action is another key point for successful treatment. Integration between doctors, nurses and physiotherapists not only guarantees the safety of the procedure, but also promotes early rehabilitation, therapeutic adherence and a reduction in complications. This collaboration allows for the personalization of care, adequate clinical monitoring and the maintenance of long-term results.

Finally, the updated international guidelines have broadened the indications for bariatric/metabolic surgery, incorporating clinical criteria and not just anthropometric ones. This change reflects the recognition of surgery as a strategy for early control of metabolic diseases, including in patients with a BMI between 30 and 35 kg/m² with comorbidities refractory to clinical treatment.

## CONCLUSION

Bariatric surgery is one of the most effective and safe medical interventions in the treatment of obesity and its comorbidities, with a direct impact on mortality, quality of life and reduction in public health costs. Its success is directly related to technical and scientific development, advances in clinical guidelines and, above all, integration between the different areas of health involved in patient care.

Over the last two decades, the evolution of surgical techniques, the valorization of the multi-professional team and the expansion of clinical indications have contributed to bariatric surgery ceasing to be an alternative of last resort and becoming a central and early therapeutic strategy for dealing with severe obesity and metabolic syndrome.

This reaffirms the need to strengthen public policies that guarantee safe and equitable access to surgical treatment, ensuring that it is accompanied by continuous interdisciplinary support, long-term monitoring and health education, with a focus on sustainable results.

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