

Cost-benefit analysis of surgical appendectomy in the Brazilian public health system

Análise de custo-benefício cirúrgico de apendicectomia no sistema de saúde público brasileiro

Análisis del costo beneficio quirúrgico de la apendicectomía en el sistema de salud público brasileño

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Abstract

Objectives: To compare the number of hospitalized patients, the number of deaths, days of hospitalization, and values of hospital services with open appendectomy and video-laparoscopic appendectomy procedures. To compare the cost-benefit of open appendectomy and video-laparoscopic appendectomy procedures. To compare the effectiveness of open appendectomy and video-laparoscopic appendectomy procedures. **Methodology:** This research was carried out through a retrospective, quantitative study, with temporal secondary data collected from the DATASUS database. Scientific articles collected on the electronic data platform Scientific Electronic Library Online (SCIELO), US National Library of Medicine (PubMed), and the Ministry of Health (MS) were used to discuss the results. **Results:** The number of open appendectomies increased by 130.86% from 2008 to 2018, while the number of video-laparoscopic appendectomies increased by 708.31%. The most developed Brazilian regions, that is, South and Southeast, totaled more than half of all laparoscopic procedures performed in Brazil, adding up to 85.52% of the total value. The death rate was 0.27% in open appendectomy and 0.09% in video-laparoscopic appendectomy. Therefore, the death rate was 66.7% lower in video-laparoscopic appendectomy. The average cost to the public coffers was 383.02 Reais for each open appendectomy and 403.02 Reais for each closed appendectomy. **Conclusion:** The analysis of the unknowns related to appendicitis surgeries shows that factors such as deaths, the average length of stay, and the value of hospital services have significant differences for the doctor and the patient.

Keywords: Appendicitis; Laparoscopy; Laparotomy.

Resumo

Objetivos: Comparar o número de pacientes internados, o número de óbitos, dias de internação e valores de serviços hospitalares com procedimentos de apendicectomia aberta e videolaparoscópica. Comparar o custo-benefício dos procedimentos de apendicectomia aberta e videolaparoscópica. Comparar a eficácia dos procedimentos de apendicectomia aberta e videolaparoscópica. **Metodologia:** Esta pesquisa foi realizada por meio de um estudo retrospectivo, quantitativo, com dados secundários temporais coletados no banco de dados DATASUS. **Artigos**

científicos coletados na plataforma de dados eletrônicos Scientific Electronic Library Online (SCIELO), US National Library of Medicine (PubMed) e Ministério da Saúde (MS) foram utilizados para discutir os resultados. Resultados: O número de apendicectomias abertas aumentou 130,86% de 2008 a 2018, enquanto o número de apendicectomias videolaparoscópicas aumentou 708,31%. As regiões brasileiras mais desenvolvidas, ou seja, Sul e Sudeste, somaram mais da metade de todos os procedimentos laparoscópicos realizados no Brasil, somando 85,52% do valor total. A taxa de mortalidade foi de 0,27% na apendicectomia aberta e 0,09% na apendicectomia videolaparoscópica. Portanto, a taxa de mortalidade foi 66,7% menor na apendicectomia videolaparoscópica. O custo médio para os cofres públicos foi de 383,02 reais para cada apendicectomia aberta e 403,02 reais para cada apendicectomia fechada. Conclusão: A análise das incógnitas relacionadas às cirurgias de apendicite mostra que fatores como óbitos, tempo médio de permanência e valor dos serviços hospitalares apresentam diferenças significativas para o médico e o paciente.

Palavras-chave: Apendicite; Laparoscopia; Laparotomia.

Resumen

Objetivos: Comparar el número de pacientes hospitalizados, el número de muertes, los días de hospitalización y los valores de los servicios hospitalarios con procedimientos de apendicectomía abierta y apendicectomía videolaparoscópica. Comparar el costo-beneficio de los procedimientos de apendicectomía abierta y videolaparoscópica. Comparar la efectividad de los procedimientos de apendicectomía abierta y videolaparoscópica. **Metodología:** Esta investigación se realizó a través de un estudio retrospectivo, cuantitativo, con datos secundarios temporales recolectados de la base de datos DATASUS. Se utilizaron artículos científicos recopilados en la plataforma de datos electrónicos Scientific Electronic Library Online (SCIELO), la Biblioteca Nacional de Medicina de EE. UU. (PubMed) y el Ministerio de Salud (MS) para discutir los resultados. Resultados: El número de apendicectomías abiertas aumentó un 130,86 % de 2008 a 2018, mientras que el número de apendicectomías videolaparoscópicas aumentó un 708,31 %. Las regiones brasileñas más desarrolladas, es decir, Sur y Sudeste, totalizaron más de la mitad de todos los procedimientos laparoscópicos realizados en Brasil, sumando el 85,52% del valor total. La tasa de mortalidad fue del 0,27% en la apendicectomía abierta y del 0,09% en la apendicectomía videolaparoscópica. Por tanto, la tasa de mortalidad fue un 66,7% menor en la apendicectomía videolaparoscópica. El costo promedio para las arcas públicas fue de 383,02 reales por cada apendicectomía abierta y 403,02 reales por cada apendicectomía cerrada. Conclusión: El análisis de las incógnitas relacionadas con las cirugías de apendicitis muestra que factores como las muertes, la estancia media y el valor de los servicios hospitalarios tienen diferencias significativas para el médico y el paciente.

Palabras clave: Apendicitis; Laparoscopia; Laparotomia.

1. Introduction

The vermiform appendix is a diverticulum located in the large intestine, which is a site for absorbing digestive waste and preparing stool. It is located in the retrocecal region, but the anatomical position of the vermiform appendix may differ from one individual to another. Regarding its histology, it contains a triangle mesenteric tissue and also a lymphoid mass, with a total size ranging from 6 to 10 cm (Moore et al., 2014)

One of its pathologies is acute appendicitis, an inflammatory process of the vermiform appendix, which commonly affects young people between 10 and 20 years of age (César et al., 2020). This inflammation is caused by obstruction of the appendix lumen either by lymphoid hyperplasia or the presence of fecaliths (small, hardened stool mass), foreign body (e.g., swallowed nail fragments or seeds), or even helminths inside. In addition to leading to the inflammatory process, these changes can lead to necrosis and also to increased bacterial growth, causing an infectious process (Coelho, 2005; Rodrigues et al., 2008; Evers et al., 2016)

The symptomatology of acute appendicitis can be classic or nonspecific. Epigastric pain, right iliac fossa pain, periumbilical pain, and diffuse abdominal pain are among the classic symptoms. Non-specific symptoms consist of nausea, vomiting, and diarrhea but there may be other variations in some cases, which can lead to the elaboration of differential diagnoses of acute abdomen (Matos et al., 2011; Freitas & Mizuno, 2019).

The diagnosis can be clinical-semiological or via imaging. The clinical diagnosis is performed by the classic symptoms associated with changes in the semiology of the abdominal physical examination, the most common being Blumberg's sign, characterized by sudden decompression at the McBurney's point, which is located one-third from the imaginary oblique line, drawn between the umbilical scar and the right iliac crest. Other semiological signs of appendicitis

consist of Rovsing's sign (right inguinal pain under palpation in the left inguinal region), iliopsoas sign (pain when extending and abducting the right leg when the individual is in the left lateral decubitus position), obturator sign (supra pubic pain on flexion and hip internal rotation), and Lenander's sign (1 °C difference between axillary and rectal temperature) (Thees, 2018). In contrast, the diagnosis by imaging examination can be performed preferably via ultrasonography or computed tomography (Moore et al., 2014; Mark et al., 2014).

Regarding treatment, current evidence shows that clinical therapy for acute appendicitis in uncomplicated or complicated situations is effective, but appendectomy, another treatment for this disease, is one of the most common procedures both in the area of urgent and emergency surgery and elective surgery. Thus, the large number of these surgeries is explained by the risk of a worse evolution of inflammation and infection of the appendix, reaching its necrosis. Therefore, the surgical procedure of laparotomy or laparoscopy is still the treatment method of choice for most cases (Malik & Bari, 2009; Santos et al., 1990).

Surgical treatment can be open or closed. When open, it is performed through laparotomy, which has three types of conventional incisions: Davis-Rockey, McBurney, or median and infraumbilical (Franzon, Piccoli & Neves, 2009). While closed, it is performed through laparoscopy and is considered a low-invasive alternative performed through minimal incisions in the abdominal wall, using high-precision surgical equipment, such as imaging equipment (visualization of the peritoneal cavity/extraperitoneal), and insufflation (maintaining continuous abdominal distention), hemostasis, aspiration, and irrigation (Figueiredo et al., 2021; Prisco, 2002), thus allowing access to the abdominal cavity.

Therefore, studies have established that the cost-benefit of the two techniques, considering the length of hospital stay, hospital discharge rate, hospital costs, and other criteria, is still not well established, requiring further studies (Guller et al., 2004; Li et al., 2010; Marins, 2013). In this context, this study aims to evaluate parameters to establish the best cost-benefit between open appendectomy and video-laparoscopic appendectomy by analyzing both procedures performed in Brazilian Public Health between 2008 and 2018.

2. Methodology

This research was carried out through a retrospective, quantitative study, having as reference the scientific methodology described by Antonio Carlos Gil. Temporal secondary data were collected from the DATASUS database. We performed an initial search in the DATASUS database, following the steps: Access to information >> Health information (TABNET) >> SUS hospital procedures/by place of admission/Brazil >> Available period. Subsequently, the appendicitis procedure by laparotomy and laparoscopy and the period from 2008 to 2018 were selected.

Subsequently, we selected the following information, considering the variables for this research: hospitalizations per year care according to the procedure, deaths per year care according to the procedure, average stay per year care according to the procedure, and value of hospital services per year care according to the procedure. After selecting the variables, we correlated them with two unknowns, namely: open appendectomy and video-laparoscopic appendectomy. The TABNET system generates tables from the selection of this information, correlating all the unknowns.

Scientific articles collected on the electronic data platform Scientific Electronic Library Online (SCIELO), US National Library of Medicine (PubMed), and the Ministry of Health (MS) were used to discuss the results. The following descriptors in Health Sciences were used: "Appendicitis," "Laparoscopy," and "Laparotomy".

The research was exempted from evaluation by the Research Ethics Committee (CEP) due to the use of public data, according to Resolution No. 510/2016 of the National Health Council.

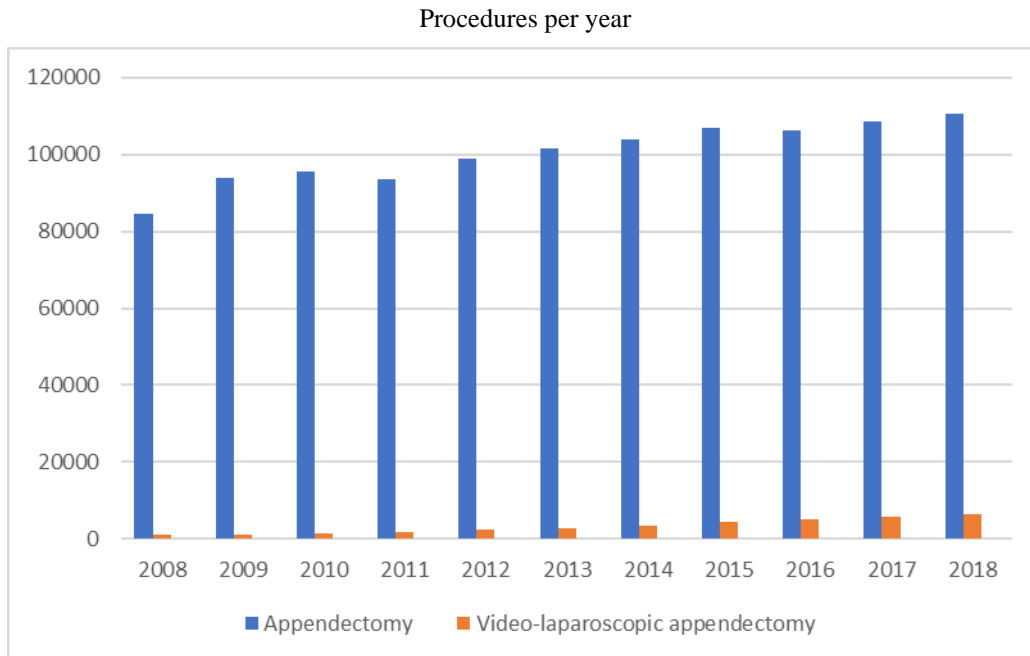
After collection, the data underwent a simple descriptive statistical analysis, and the results were presented in a graph or table format.

3. Results and Discussion

Infection of the appendix is one of the main eventualities in the area of urgency and emergency, as most of the outcomes are surgical. The total number of appendectomies performed by the Brazilian public health system, considering urgency, emergency, and elective procedures, reached 1,140,106, of which 35,527 were by video-laparoscopy, which corresponds to 3.22% of the total value of surgical procedures for performed appendicitis (Graph 1).

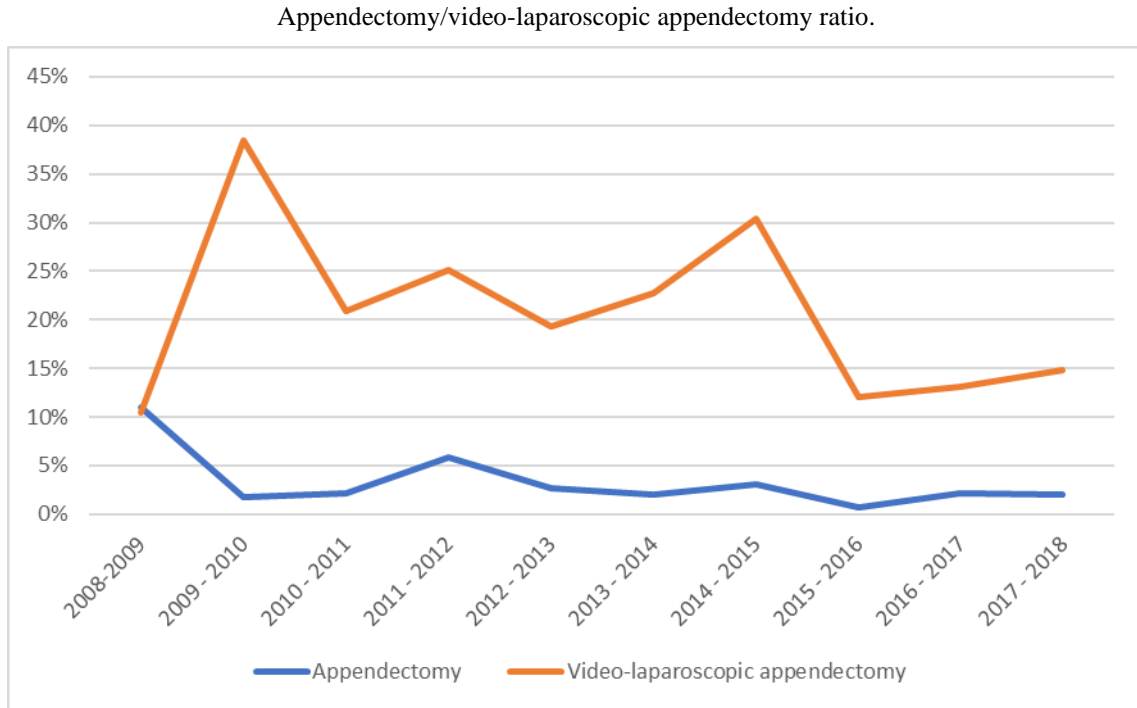
The number of open appendectomies increased by 130.86% from 2008 to 2018, while the number of video-laparoscopic appendectomies increased by 708.31%. Thus, the average increase per year was 3% for open appendectomy and 18.84% for video-laparoscopic appendectomy (Graph 2). Even with the increase in video-laparoscopic appendectomy by more than five times compared to open appendectomy, the total value of the former is still low compared to the latter.

Graph 1. Number of annual hospitalizations according to the procedure, according to DATASUS, during the period from 2008 to 2018.



Source: Authors.

Graph 2. Annual percentage between open appendectomy and video-laparoscopic appendectomy, according to DATASUS, during the period from 2008 to 2018.

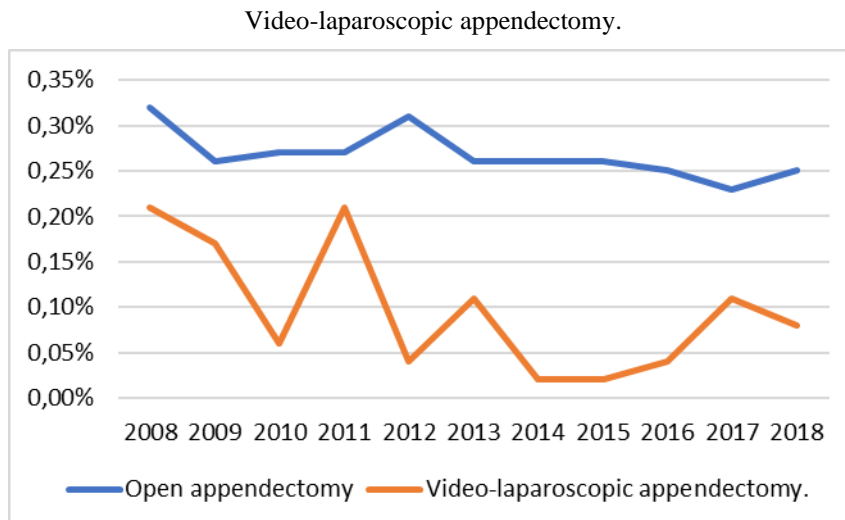


Source: Authors.

The most developed Brazilian regions, that is, South and Southeast, totaled more than half of all laparoscopic procedures performed in Brazil, adding up to 85.52% of the total value, while the Northeast region totaled 9.7%, Midwest 3.83%, and North 0.94%.

This death rate was calculated considering the number of open appendectomy and video-laparoscopic appendectomy procedures performed during the period from 2008 to 2018. The death rate was 0.27% in open appendectomy and 0.09% in video-laparoscopic appendectomy. Therefore, the death rate was 66.7% lower in video-laparoscopic appendectomy.

Graph 4. Percentage ratio per year between deaths in open appendectomy and video-laparoscopic appendectomy, according to DATASUS, during the period from 2008 to 2018.



Source: Authors.

The average annual hospital stay was 3.67 for open appendectomy and 3.47 for video-laparoscopic appendectomy.

This study showed that the public health system spent R\$ 423,077,412.64 from 2008 to 2018 on open appendectomies and R\$ 14,318,294.99 on video-laparoscopic appendectomies in hospital services. Thus, the average cost to the public coffers was 383.02 Reais for each open appendectomy and 403.02 Reais for each closed appendectomy.

Inflammation of the appendix is known in medicine as the disease acute appendicitis, being one of the most common causes of urgent and emergency care in emergency rooms. (Vieira & Sá, 2020). Thus, most of the cases are treated surgically either through open appendectomy or video-laparoscopic appendectomy (Freitas & Mizuno, 2019).

The development of the video-laparoscopic surgery technique represented an evolution in the surgical treatment of this disease, as it is minimally invasive. Although the results of the analyzed data show that video-laparoscopic surgery has been performed in lesser amounts in Brazil, the use of this technique has increased significantly in recent years. It occurs because current studies show that video-laparoscopy is a technique with greater benefits (Hillesheim, 2018).

As discussed, closed appendectomy has a high incidence in Brazil, mainly due to the criteria for choosing one surgical technique over the other. Health conditions and pre-existing comorbidities, the hospital's level of technological adequacy, and the surgeon's knowledge about each technique, as the surgeon should choose the one in which he or she has greater knowledge and ability, are among the factors analyzed for choosing the most appropriate surgical technique for each patient's profile (Lima et al., 2012). Another important criterion to be observed when choosing the type of surgery is the technology involved in the procedure. In this sense, we can conclude that the South and Southeast are the pioneers in video-laparoscopic appendectomy, as these regions have the highest level of technological development in Brazil.

Possible surgical complications must be considered after choosing the most appropriate surgical technique. Wall abscess, residual abscesses, intestinal obstruction, fecal fistula, evisceration, eventration, peritonitis, and hemorrhage are among the most frequent surgical complications found in the literature (Bastos et al., 2021). In addition, the literature shows that complications during and after appendicitis surgery significantly interfere with the length of hospital stay of patients in the postoperative period. (Iamarino et al., 2017).

Thus, evidence from studies in the surgical area has allowed the determination of patients at higher risk for postoperative complications. This evidence shows a greater risk for patients with the following factors: age ≥ 38.5 years, choice of the open appendectomy surgical technique, complicated appendicitis, $ASA \geq 2$, and operative duration higher than 77 minutes (Moreira et al., 2018).

Concomitantly, studies related to the length of hospital stay and the type of procedure performed have clarified that video-laparoscopy had a shorter hospital stay compared to open appendectomy (Garbutt et al., 1999; Mccahill et al., 1996; Bresciani et al., 2005). Considering the postoperative period, studies have shown that the main cause of death and increase in hospitalization days consists of infection at the surgical site. Thus, laparotomy was twice as likely to develop surgical site infection as laparoscopy and, consequently, increased hospitalization days (Ban et al., 2017; Johnson & Peetz, 1998).

Several studies on postoperative appendicitis have shown that laparoscopic appendectomy has a shorter hospital stay compared to the open technique. Therefore, in addition to the lower rate of hospital stay, there is an association with a low rate of surgical site infection. (Guller, et al., 2004; Li, et al., 2010; Machado et al., 2019). The evaluation for medical discharge after the surgical procedure, includes analysis of vital signs, ability to walk, control of pain and bleeding. (Matzenbacher et al., 2021).

Last but not least, numerous studies have shown that death in video-laparoscopic appendectomy is significantly lower than in open appendectomy, as intraoperative and postoperative complications are lower (Troncoso & Nunes, 2019). Therefore, an average death rate of 66% is observed in closed procedures compared to open procedures.

Studies have shown that open appendectomy had lower hospital costs compared to video-laparoscopic appendectomy (Jurema et al., 2020; Iamarino et al., 2017). However, the Brazilian College of Surgeons compared the laparoscopic with the laparotomy technique and observed no significant difference between their costs (Marins, 2001).

The analysis of the unknowns related to appendicitis surgeries shows that factors such as deaths, the average length of stay, and the value of hospital services have significant differences for the doctor and the patient.

4. Conclusion

Currently, the scientific evidence is still too small to consider the superiority of laparoscopic appendectomy over open appendectomy, and further randomized studies on the subject are needed. However, the difference in deaths between the two surgical techniques has been significant

Thus, better results have been observed for patients who underwent video-laparoscopic surgery. Considering the recovery time and the patients' return to daily activities, video-laparoscopy showed a small advantage over open appendectomy. The death rate was also significantly lower in video-laparoscopic appendectomy.

Thus, establishing the best surgical method should not only consider the factors presented in this article but also consider other biases that could contribute to appendectomy success. For instance, the patients' pre-existing comorbidities, the technological structure of the hospital where the surgery will be performed, and the surgeon's knowledge about the different surgical techniques, among other factors, could be evaluated. Furthermore, modern medicine broke the paternalistic paradigm in which only the surgeon chose which technique should be used and, therefore, surgeons who strive for patient autonomy must present to the patient the positive and negative points of biases and the choice of the surgical technique to be performed must be shared between the patient and the surgeon who will perform the procedure, always aiming to minimize the inherent risks, improving the quality of life, and curing the patient.

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