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Introduction to Rectal Cancer and the Importance of Nerve Preservation

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ABSTRACT

Introduction: Rectal cancer is an increasingly common and worrying disease that affects the rectum, the terminal part of the large intestine. Early detection and treatment are crucial to improving patient outcomes.

Methods: We conducted a narrative review of the scientific literature to examine nerve preservation in rectal cancer surgery. Previous studies were analyzed and relevant findings related to the preservation of autonomic and pelvic nerves, as well as the prevention of sphincter dysfunction, were identified.

Results: Rectal surgeries may be associated with various complications, which can have a significant impact on patients' quality of life. The preservation of the autonomic and pelvic nerves plays a crucial role in reducing postoperative urinary and sexual dysfunction. Studies have shown that nerve-sparing surgical techniques improve functional outcomes and patient satisfaction.

Discussion: Nerve preservation in rectal cancer surgery requires a meticulous surgical approach and a thorough understanding of the anatomical structures involved. By preserving nerve function, not only urinary and sexual function are improved, but also overall quality of life. In addition, nerve preservation plays a critical role in preventing sphincter dysfunction after pelvic exenteration surgery.

Conclusions: The preservation of autonomic and pelvic nerves in rectal cancer surgery is essential to minimize complications and improve patients' quality of life. Proper patient selection and compliance with oncology criteria contribute to the preservation of sphincter function without compromising survival rates. Preoperative radiation therapy may also increase the likelihood of sphincter sparing in patients with rectal cancer

KEYWORDS: Rectal cancer, nerve preservation, urinary function, sexual function, sphincter dysfunction, postoperative complications, quality of life, rectal surgery, pelvic exenteration, preoperative radiation therapy.

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INTRODUCTION

Rectal cancer is a prevalent and concerning form of cancer that affects the rectum, the terminal part of the large intestine. It ranks as the eighth most common cancer worldwide, and its incidence is increasing, particularly among young individuals and women [1]. Early detection and treatment are crucial for improving outcomes in rectal cancer.

Rectal cancer surgeries can be associated with various complications, including injury to the spleen, anastomotic leak, wound infection, abscess, ileus, urinary dysfunction, sexual dysfunction, and postoperative medical complications [2, 3, 4, 5, 6, 7, 8, 9]. These complications can have a significant impact on the quality of life of patients, resulting in increased morbidity, prolonged recovery, and impaired daily functioning. As a result, managing and minimizing these complications is of utmost importance.

Nerve preservation plays a crucial role in rectal cancer surgery to minimize the impact on bladder and sexual

function. The autonomic nerves, particularly the pelvic autonomic nerves, are vital in maintaining normal urinary and sexual function in patients. Preserving these nerves during surgery helps to reduce the risk of postoperative bladder dysfunction and contributes to the overall quality of life of patients [10], [11]. Several studies have shown that nerve-preserving surgical techniques can result in better functional outcomes and improved patient satisfaction.

Preserving the autonomic nerves during rectal cancer surgery is a complex task that requires a meticulous surgical approach and a comprehensive understanding of the anatomical structures involved. Surgeons must carefully navigate and protect the delicate nerves while removing the cancerous tissue. The goal is to achieve oncological clearance while preserving nerve function and minimizing postoperative complications.

In addition to preserving urinary and sexual function, nerve preservation in rectal cancer surgery has also been associated with better outcomes in terms of overall quality of life. Patients who retain normal bladder and sexual function experience improved physical and emotional well-being, reduced dependency on medical interventions, and enhanced social interactions. Preserving nerve function goes beyond treating the cancer itself; it is about preserving the patient's dignity, body image, and overall sense of self.

METHODOLOGY

To investigate the importance of nerve preservation in rectal cancer, a comprehensive research methodology will be employed. The methodology will involve systematic literature review and analysis, focusing on identifying and understanding the significance of nerve preservation techniques in the context of rectal cancer surgeries.

RESEARCH QUESTION

The primary research question is to explore the importance of nerve preservation in rectal cancer surgeries and its impact on patient outcomes.

LITERATURE SEARCH

A systematic literature search will be conducted in reputable medical databases including PubMed, Embase, and Cochrane Library. The search will encompass articles published between January 2010 and July 2023. The search will be restricted to publications in English or Spanish.

The search strategy will involve the use of controlled vocabulary (MeSH terms) and relevant keywords related to the topic. Key terms and their combinations will be utilized, employing Boolean operators and proximity operators as needed. Some of the terms to be included are:

Rectal cancer, Rectal tumor, Nerve preservation, Nerve-sparing surgery, Autonomic nerves, Patient outcomes, Functional outcomes, Oncological outcomes, Bowel function, Urinary function, Sexual function, Quality of life, Surgical techniques, Minimally invasive surgery, Laparoscopic surgery, Robotic surgery, etc.

Inclusion Criteria: Studies meeting the following criteria will be considered for inclusion: Studies investigating and describing nerve preservation techniques in rectal cancer surgeries. Studies reporting on patient outcomes (functional and oncological) after nerve-sparing surgeries. Research published in peer-reviewed medical journals. Articles available in English or Spanish. Studies published between January 2010 and July 2023. Exclusion Criteria: Studies not focusing on nerve preservation techniques in rectal cancer surgeries or those not relevant to the research question will be excluded.

REVIEW PROCESS

Two independent reviewers will evaluate the titles and abstracts of the identified articles from the search. Any disagreements will be resolved through discussion or by consulting a third reviewer if needed. Relevant articles will undergo full-text review to assess their alignment with the inclusion criteria.

Data extracted from the selected studies will include information on various nerve preservation techniques employed in rectal cancer surgeries. Patient outcomes related to bowel function, urinary function, sexual function, and quality of life will also be extracted. The collected data will be synthesized and analyzed narratively. Patterns, trends, and variations in nerve preservation techniques and their impact on patient outcomes will be identified and discussed. The findings will be presented in a narrative synthesis format, outlining the significance of nerve preservation techniques in rectal cancer surgeries. Specific examples of different nerve-sparing approaches and their clinical implications will be highlighted. Possible limitations, such as the availability of articles, the quality of studies included, and the generalizability of findings, will be acknowledged in the final discussion.

RESULTS

Understanding Sphincter Dysfunction in Rectal Cancer Surgery

Sphincter dysfunction refers to the deterioration or abnormal functioning of the sphincter muscles, responsible for controlling the opening and closing of various passages in the body. In rectal cancer, sphincter dysfunction can manifest as various symptoms that affect bowel function.

According to a systematic [review12], patients who undergo rectal cancer surgery to preserve the sphincter may experience symptoms such as bowel changes, bowel dysfunction, incontinence, urgency, and frequent bowel movements. These symptoms together contribute to a condition called low anterior resection syndrome (RARS). RARS can have a significant impact on a patient's quality of life, affecting their ability to function as they wish, both socially and in their chosen role.

Another study13 evaluated Chinese patients who underwent sphincter-sparing surgery due to medium to low rectal cancer. The study found that approximately 76% of patients developed RAS after surgery, and 35.6% experienced severe RAS. The severity of the RAS was associated with symptoms such as bowel dysfunction, including changes in bowel habits and incontinence.

It is important to note that sphincter dysfunction can vary between individuals, and the specific symptoms and their severity may differ. The impact on quality of life can also vary depending on the individual and the extent of sphincter dysfunction.

Sphincter dysfunction in rectal cancer patients can cause symptoms such as bowel changes, bowel dysfunction, incontinence, urgency, and frequent bowel movements. These symptoms can significantly affect a patient's quality of life, and healthcare professionals should strive to understand and address these symptoms to improve patient outcomes.

Nerve preservation plays a critical role in preventing sphincter dysfunction after pelvic exenteration surgery. Studies have shown that proper patient selection and compliance with oncological criteria contribute to sphincter preservation without compromising survival rates [14]. Factors such as volume of hospital procedures, urban location, patient demographics (age, gender, race, body mass index), tumor size, and distance from the anal margin have been identified as predictors of sphincter preservation [15], [16].

In addition, preoperative radiotherapy has been found to increase the likelihood of sphincter preservation in patients with rectal cancer [17]. Short-term preoperative radiation therapy has demonstrated a high rate of sphincter-sparing surgery with acceptable anorectal function and few complications. In addition, preoperative chemoradiation therapy has been associated with increased eligibility for sphincter preservation in patients with rectal cancer less than 3 cm from the anal margin [18].

Nerve preservation techniques in rectal cancer surgery

Preserving nerves in colorectal cancer surgery is an important consideration to minimize the risk of complications and improve patient outcomes. While the search results provided do not specifically address techniques for preserving nerves in colorectal cancer, it is worth noting that nerve preservation is a complex aspect of surgical treatment that requires careful consideration by the surgeon.

In colorectal cancer surgery, the goal is to remove the tumor while preserving nerve function to minimize the risk of complications such as urinary and sexual dysfunction. Surgeons may employ various techniques to achieve nerve preservation, including:

1. Nerve-sparing surgery: This approach involves careful dissection and preservation of the nerves surrounding the tumor. The surgeon aims to remove the cancerous tissue while sparing the nerves responsible for urinary and sexual function.
[19]

2. Total mesorectal excision (TME): TME is a surgical technique commonly used in rectal cancer surgery. It involves the meticulous dissection of the rectum and surrounding tissues to remove the tumor and its associated lymph nodes while preserving the nerves.
[19]

3. Laparoscopic or robotic-assisted surgery: Minimally invasive techniques, such as laparoscopic or robotic-assisted surgery, can offer better visualization and precision during the procedure. These techniques may aid in nerve preservation by allowing the surgeon to navigate delicate structures more effectively.[[19]].

Robotic rectal cancer surgery is another approach that can facilitate the identification and preservation of autonomic nerves. Studies have reported high rates of urogenital dysfunction after open and laparoscopic surgery for rectal cancer, but robotic surgery has shown potential for preserving urogenital function. Several studies have reported earlier recovery or better outcomes in urinary and sexual function in patients undergoing robotic rectal cancer surgery [20].

It is important to note that the choice of nerve sparing technique may depend on several factors, such as the stage of the cancer, the location of the tumor, and the experience of the surgeon. Each technique has its own advantages and considerations, and the decision should be based on the individual characteristics and preferences of the patient.

The emergence of laparoscopic surgery has had a significant impact on nerve preservation in rectal cancer surgeries. Laparoscopic surgery, a minimally invasive approach, offers better visualization and accuracy during the operation. This has resulted in increased preservation of the pelvic autonomic nerves responsible for urinary and sexual function.

Several studies have examined the effects of laparoscopic surgery on nerve preservation in rectal cancer surgeries. Study [21] investigated laparoscopic mesorectal excision with preservation of pelvic autonomic nerves. The study demonstrated the feasibility of this approach and reported favorable results in postoperative urinary and sexual function. Similarly, Study [22] focused on curative excision of pelvic autonomic nerve-sparing laparoscopic rectal cancer (PANP). The study found that laparoscopic surgery with PANP did not worsen or improve sexual and urinary dysfunction.

In addition, there is evidence to suggest that laparoscopic surgery for rectal cancer achieves oncological outcomes comparable to open surgery. Study [23] compared laparoscopic and open surgery for rectal cancer and observed similar long-term survival rates between the two approaches.

Laparoscopic surgery has positively influenced nerve preservation in rectal cancer surgeries by providing better visualization and accuracy. Laparoscopic mesorectal excision and curative excision of nerve-sparing laparoscopic rectal cancer have shown promising results in urinary and sexual function.

The choice of nerve preservation technique in surgical interventions is influenced by several factors. First, the

location of the tumor plays a crucial role in determining the approach and technique used for nerve preservation. Different tumors have unique anatomical relationships with nearby nerves, and the proximity of the tumor to critical nerves may influence the decision to preserve or sacrifice the nerve. For example, in vestibular schwannoma surgery, tumor origin in either the superior vestibular nerve or the inferior vestibular nerve has been found to be a significant prognostic factor for cochlear nerve preservation. Tumors originating in the superior vestibular nerve show a higher rate of hearing preservation compared to those originating in the inferior vestibular nerve [24].

Second, tumor stage also plays a critical role in the selection of nerve preservation techniques. In cases such as rectal cancer surgery, preserving the pelvic autonomic nerves responsible for bladder and sexual function is thought to minimize postoperative dysfunction. Extensive research has shown that preserving pelvic autonomic nerves can significantly reduce bladder dysfunction and should be a crucial consideration in surgical planning [10].

In addition, the experience and expertise of the surgeon significantly influence the choice of nerve preservation technique. Surgical skill and familiarity with various techniques are critical factors in achieving successful nerve preservation. Numerous studies have revealed that experienced surgeons tend to get better results in terms of complete removal of the tumor and preservation of facial nerve function. Their expertise improves the overall success rates of nerve preservation procedures [25].

In addition, patient preferences play an integral role in the decision-making process. Factors such as the patient's desire to preserve auditory or facial nerve function, as well as general considerations about their quality of life, may influence the choice of technique. For example, in the management of large vestibular schwannomas, patients may opt for radiosurgery treatment instead of repeated surgical resection to preserve facial nerve function, taking into account the possible risks and benefits [26].

Benefits of Nerve Preservation in Rectal Cancer Surgery

Sparing nerves is a critical factor in maintaining sphincter function after surgery. Several studies have explored the impact of nerve preservation on bladder, sexual and anal function in patients undergoing different types of surgeries. In rectal cancer surgery, preservation of pelvic autonomic nerves has been shown to minimize bladder dysfunction and maintain normal sexual function in male patients [10]. Preservation of autonomic nerves during anterior resection for rectal cancer has also been found to decrease postoperative dysfunction of defecation, urination, and sex life without compromising survival [27].

Similarly, in sigmoid colon cancer surgery, laparoscopic surgery sparing the pelvic autonomic nerves has led to good results in urination and sexual function [28]. Preservation of autonomic nerves during these procedures has shown positive effects on functional outcomes, including urination function, urinary continence, and sexual function.

In addition, in the treatment of complex anal fistula, preserving sphincter function through surgical methods such as TROPIS and SCT has been associated with better cure rates, lower recurrence rates, and fewer postoperative complications [29].

In general, preserving nerves during surgery is crucial to maintaining sphincter function after surgery. It can help minimize bladder dysfunction, preserve sexual function, reduce postoperative dysfunction of defecation, urination, and sex life, and improve the quality of life of patients undergoing surgery for rectal cancer, sigmoid colon cancer, and complex anal fistula.

Nerve preservation in rectal cancer surgery is a surgical approach aimed at minimizing damage to the pelvic autonomic nerves, which play a crucial role in bladder and sexual function. By preserving these nerves during surgery, it is believed that operative and postoperative morbidity can be reduced, leading to better patient outcomes.

Numerous studies have investigated the effects of nerve preservation on functional and oncological outcomes in rectal cancer surgery. For example, a prospective study conducted in the Netherlands evaluated the functional outcome, local recurrence, and survival of rectal cancer patients who underwent a Japanese operative technique that combines nerve preservation with radical tumor resection [10]. The study found that preserving pelvic autonomic nerves minimized bladder dysfunction after surgery, and only a small percentage of patients experienced minor urinary incontinence or persistently elevated frequency of urination.

Another study examined long-term urination and sexual function after pelvic nerve-sparing radical surgery for rectal cancer [11]. The results revealed that most patients maintained voluntary urination without the need for long-term catheterization. However, it is important to note that there was a high incidence of erectile dysfunction in male patients, indicating that sexual function may be compromised to some extent.

In addition, a study focused on autonomic nerve-sparing surgery for rectal cancer investigated the impact on urination and sexual function [30]. The study found that urination function was not significantly affected after surgery, but sexual function was aggravated. To mitigate the impact on sexual function, the study recommended assessing baseline genitourinary function prior to treatment and implementing penile rehabilitation to improve patients' quality of life.

In recent years, robotic-assisted surgery has also been explored as a potential approach to rectal cancer surgery. Some studies have suggested that robotic surgery may have better outcomes compared to laparoscopic surgery, including earlier recovery and better preservation of male sexual function [20], [31]. However, more research is needed to fully understand the benefits and limitations of robotic-assisted

surgery in relation to nerve preservation and reduction of operative morbidity.

Future directions and challenges in nerve preservation in rectal cancer surgery

Nerve preservation techniques in rectal cancer surgery have experienced significant advances and changing trends in the last [10] years. These techniques aim to minimize postoperative complications, particularly bladder and sexual dysfunction, and improve outcomes for the patient.

A notable trend is the adoption of mesorectal total excision (TME) with preservation of autonomic nerves. Studies have shown that SMT, combined with careful dissection and preservation of autonomic nerves, can effectively reduce the risk of bladder and sexual dysfunction without compromising oncological outcomes [10]. This approach emphasizes the importance of accurate anatomical dissection and nerve-sparing techniques during surgery.

Another promising advance is the use of neoadjuvant chemoradiotherapy (CRT) in locally advanced rectal cancer. Neoadjuvant CRT has been found to shrink tumors, increase the likelihood of sphincter-sparing surgery, and facilitate nerve preservation. It allows a more conservative approach, preserving the rectum and associated nerves, while achieving satisfactory oncological results [32].

In recent years, minimally invasive techniques such as laparoscopic and robotic-assisted surgery have gained popularity. These approaches offer better visualization, greater dexterity, and precise instrumentation, allowing surgeons to perform nerve-sparing procedures with greater precision. Studies have shown that laparoscopic and robotic-assisted surgeries for rectal cancer can achieve comparable oncological outcomes, while potentially minimizing the risk of nerve damage [33], [34].

In addition, advances in imaging technologies, such as magnetic resonance imaging (MRI) and ultrasound, have facilitated preoperative evaluation and mapping of nerve structures, helping surgeons identify and preserve vital nerves during rectal cancer surgery.

Overall, current trends in nerve-sparing techniques in rectal cancer surgery emphasize a multidisciplinary approach, including neoadjuvant treatment, precise anatomical dissection, and the application of minimally invasive technologies. These advances aim to improve functional outcomes, improve patients' quality of life, and ensure oncological safety during rectal cancer surgery.

Patient outcomes regarding nerve preservation in rectal cancer surgery can be further improved through several strategies. First, it is essential to perfect the surgical technique, with a thorough dissection and identification of the pelvic autonomic nerves [10]. Robotic surgery has also shown promise for improving outcomes, including nerve preservation, due to its increased precision and dexterity [35], [33]. A multidisciplinary approach involving collaboration between health professionals can optimize outcomes by adapting treatment plans [36].

Patient education and involvement are crucial, as informed patients can have realistic expectations and contribute to decision-making [10]. Ongoing research and participation in clinical trials play a vital role in advancing nerve preservation techniques. In addition, factors such as individual patient characteristics and tumor location should be considered for personalized treatment planning [11]. Postoperative care, which includes physiotherapy and close monitoring of urinary and sexual function, can help in rehabilitation and timely intervention [30].

Overall, incorporating surgical technique refinement, robotic surgery, a multidisciplinary approach, patient education, ongoing research, and postoperative care can improve patient outcomes for nerve preservation in rectal cancer surgery.

CONCLUSION

Rectal cancer is a prevalent and worrisome form of cancer that affects the rectum, the terminal part of the large intestine. Its incidence is increasing, especially among young people and women [1]. Early detection and treatment are crucial to improving outcomes in rectal cancer.

Surgeries for rectal cancer can be associated with various complications, such as spleen injuries, anastomotic leaks, wound infections, abscesses, ileus, urinary dysfunction, sexual dysfunction, and postoperative medical [complications.2], [3, 4], [5, 6], [7], [8], [9]. These complications can have a significant impact on patients' quality of life, resulting in increased morbidity, prolonged recovery, and impaired daily function. Therefore, it is of utmost importance to manage and minimize these complications.

Nerve preservation plays a crucial role in rectal cancer surgery to minimize the impact on bladder and sexual function. Autonomic nerves, especially pelvic autonomic nerves, are vital for maintaining normal urinary and sexual function in patients. Preserving these nerves during surgery helps reduce the risk of postoperative bladder dysfunction and contributes to patients' overall quality of life [10], [11]. Several studies have shown that nerve-sparing surgical techniques can result in better functional outcomes and increased patient satisfaction.

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