

## **Surgical approaches and techniques in cancer treatment: past, present, and future**

### **Abordagens e técnicas cirúrgicas no tratamento oncológico: passado, presente e futuro**

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**ABSTRACT**

*Introduction:* Oncological surgery is one of the main pillars in the cancer treatment. Despite the significant advances of immunotherapies, target therapies, chemotherapies, and radiotherapies, surgery continues as an essential therapy. *Objective:* to present an updated overview of the oncological surgery's role, highlighting its evolution throughout history and the current approaches and techniques in cancer treatment. *Methods:* Narrative and exploratory bibliographic study. The research was carried out in the Medline and Embase databases, using the terms (((surgical oncology)) OR ((surgery) AND (cancer) OR (tumors))). *Results:* Oncological surgery has made significant advances over its history. Currently, what prevails is the minimally invasive mentality with the techniques of video laparoscopy and robotic surgery. Although access is not uniform throughout the world, the expectation is that more popularization of these techniques will occur in the coming years. The oncological surgery is indicated to prevent, diagnose, evaluate the disease's spread, curative treatment, sequelae and complications management, as well as palliation. *Conclusion:* Surgery is a procedure that improves the quality of life and increases cancer patients' survival. The knowledge of its applicability, different techniques, and future expectations is essential for the correct orientation, referral to specialists, and patient's follow-up.

**Keywords:** surgical oncological, laparoscopy, robotic surgical procedures, medical oncology.

**RESUMO**

*Introdução:* A cirurgia oncológica constitui um dos principais pilares no tratamento do Câncer. Apesar dos grandes avanços de imunoterapias, terapias alvo, quimioterapias e radioterapias, nos últimos anos, a cirurgia continua como uma terapêutica fundamental. *Objetivo:* apresentar um panorama atualizado sobre o papel da cirurgia oncológica, destacando sua evolução ao longo da história e as atuais abordagens e técnicas no tratamento do câncer. *Métodos:* Estudo bibliográfico narrativo e exploratório. Realizada pesquisa nas bases de dados Medline e

Embase, utilizando os termos (((surgical oncology)) OR ((surgery) AND (cancer) OR (tumors))). *Resultados:* A Cirurgia oncológica teve avanços significativos no decorrer de sua história. Atualmente o que prevalece é a mentalidade minimamente invasiva com as técnicas de vídeo-laparoscopia e cirurgia robótica. Embora o acesso não seja uniforme em todo mundo, a expectativa é que para os próximos anos ocorra cada vez mais a popularização dessas técnicas. A cirurgia oncológica pode ser realizada com o intuito de prevenção, diagnóstico, avaliação da disseminação da doença, tratamento curativo, manejo das sequelas e complicações, além de palição. *Conclusão:* A cirurgia é um procedimento que melhora a qualidade de vida e aumenta a sobrevida dos pacientes oncológicos. O conhecimento de sua aplicabilidade, das diferentes técnicas e das expectativas futuras é fundamental para a correta orientação, encaminhamento para especialistas e seguimento de pacientes.

**Palavras-chave:** oncologia cirúrgica, laparoscopia, telecirurgia, oncologia.

## 1 INTRODUCTION

Oncological Surgery is one of the fundamental pillars in the treatment of solid tumors. Despite significant advances involving chemotherapy, radiotherapy, target therapies, and immunotherapies, its role remains essential for patients to achieve a cure with a substantial increase in survival. In cancer treatment, surgery can be performed to prevent, diagnose, evaluate the disease's spread, curative treatment, sequelae and complications management, as well as palliation. (1,2)

Given the subject relevance and the absence of updated reviews, the present study aims to present, in a clear and accessible way, an updated overview of the oncological surgery role, highlighting its evolution throughout history and the current approaches and techniques in cancer treatment. The knowledge of the indication and the surgical procedures is essential for health professionals and students since they will be the ones to forward their patients to the oncology surgeons and will need to know the possible surgical conducts to follow their patients in the best way possible.

## 2 METHODS

Narrative and exploratory bibliographic study was performed. A search of the Medline and EMBASE databases using the terms (((surgical oncology)) OR ((surgery) AND (cancer) OR (tumors))). All terms mentioned were used as *MeSH Terms*, *Title/Abstract*, and *Text-Wide Free Terms* in the search strategy. The authors did not restrict any article regarding language nor year of publication.

### 3 HISTORY OF ONCOLOGICAL SURGERY

From antiquity to the present day, surgery is one of the main pillars in cancer patients' treatment. This therapy was the only possibility for most cancer tumors in past centuries since the other treatments had not yet been discovered. With the emergence of anesthesia and asepsis, in the second half of the 19<sup>th</sup> century, the surgery took on an even greater role. (1)

The American surgeon, William Halsted, in the late 19<sup>th</sup> century described radical mastectomy. This procedure was considered for decades the golden standard in breast cancer surgeries. It is currently an unnecessary radical surgery, but it was revolutionary and responsible for saving many lives in its time. (3)

The oncological principles advocated by Halsted were applied in addition to breast tumors in cervical, colon and rectum, pancreas, and head and neck cancers. However, the risk of surgical complications and mortality was still very high; once there was no scientific basis, the hygiene controls were precarious and there were shortages of pre- and post-surgical medications. During this period, it was claimed that blood was of no importance in the spread of the disease, tumors were independent of their host, and cancer was a local disease that spread in an orderly manner through mechanical factors. (1,2)

Over time, new techniques and procedures emerged until clinics and laboratory research guided them in 1957. New scientific bases were being proven and accepted, demystifying old precepts. Gradually it was established that cancer was a systemic disease in which the bloodstream had a crucial role in its dissemination; it exposed the complex relationships between the tumor and the host that affected the evolution of the disease, explaining why the radical local therapies did not always result in the cure. Radiotherapy added improvements to cancer treatment from the 1970s onwards when it started being combined with surgery. Such therapeutic association resulted in a large increase in cancer patients' survival, and complete cancer healing was already possible in 50% of cases. At this time, chemotherapy was also initiated for certain tumors at high risk of metastasis. (1,4)

The end of the 20<sup>th</sup> century brought new radiotherapy equipment and new effective chemotherapy schemes to abandon some more radical surgeries. Therefore, it began to adopt a new mentality seeking the realization of minimally invasive procedures, seeking the maximum preservation of the affected organ. At that moment, two-thirds of the cancer patients were already healed. In this scenario, in the 1990s, there was also the advent of laparoscopic surgery that became the standard model for various procedures, revolutionizing surgical technologies. (1,5)

In the 21<sup>st</sup> century, the advancement of radiotherapy and chemotherapy (with specific target modern drugs, immunomodulation, and personalized therapy) has brought better prognosis, improving patients' quality of life. Therefore, the surgery began to take on a level of adjuvant treatment of neoplastic diseases. The use of regional and systemic adjuvant therapies in radiation, chemotherapy and hormone therapy, target therapy, immunotherapy, gene therapies, linked to the increasing ability to diagnose progressively smaller tumors, played an essential role in reducing the need to contemplate the use of radical surgery. (1,2)

The surgical procedures also changed concerning the treatment decision, seeking to carry out options guided by multidisciplinary teams' discussions and focused on the cancer patient. From new horizons, there is molecular biology, genetics, advanced computer-enhanced technologies, such as surgical robots, three-dimensional images (3D), graphical computing, and computer simulation technology that have come to revolutionize cancer treatment and the future of surgery. (1,5)

#### **4 IMPORTANCE OF SURGERY FOR ONCOLOGICAL TREATMENT**

In the third edition of The Cancer Atlas, the American Cancer Society announced catastrophic forecasts of the growth in cancer incidence and mortality worldwide. A significant increase in the number of new cases is estimated from approximately 14 million in 2012 to 19.3 million in 2025. Furthermore, an expansion of death numbers is projected around 8 to 11.4 million, comparing 2012 with 2025. With these data, the trend is confirmed that cancer, in the coming decades, will be the leading cause of death worldwide, regardless of socioeconomic conditions. (6)

The World Health Organization estimated that effective preventive measures could have reduced cancer cases worldwide by up to 40% in 2015. Including the 15.2 million cancer cases in the same year, at least 80 % needed a surgical procedure at some point in the disease but did not necessarily receive this therapy. This way, despite advances in the field of radiotherapy and chemotherapy, surgery remains the gold standard in prevention, diagnosis, treatment, palliative care, and reconstructions when it comes to cancer. (6)

Surgery is vital for reducing mortality and morbidity in oncology. The global panorama presents significant disparity and inequality concerning its access. The Global Cancer Surgery report, published in 2015, showed the global deficiencies of operative reach: the report estimates that around 5 billion people do not have access to safe and accessible surgical and anesthetic care when needed, especially in low- and middle-income countries. Another point is the imbalance in the financing and distribution of cancer surgery resources concerning the

different forms of cancer treatment. Only 9% of the total resources are destined for the oncological operation. In almost all countries, the funds are destined mainly to the private sector, increasing inequity of access concerning the public sector. The report's commission also described the deficit in countries most poor of investments in research, training, and education related to services that support fundamental surgery, such as pathology, imaging, and anesthesia. The reduction of deaths and consequences within oncology largely depends on access to surgical and anesthetic care, which must be available, efficient, accessible, and safe to guarantee good results and prognosis. (7)

## 5 CURRENT TECHNIQUES

The scalpel is no longer the symbol of surgery. Medical research in conjunction with engineering enables new technological advances, reaching even robotic surgeries. It is still a distant reality that robotic techniques replace open surgery or laparoscopy, mainly due to the high costs of technology and the high technical preparation required. However, several advanced computer-enhanced methods, such as surgical robots, three-dimensional images (3D), computer graphics (CG), computer simulation technology, are already a reality in several centers worldwide, making it possible to perform minimally invasive procedures. (1,5)

Improvements in chemotherapy administration and the emergence of new drugs with less toxicity, available for oral use, allowing patients to take the medication at home, are already reachable. In radiotherapy, the electromagnetic beams gained greater precision with the aid of 4D tomography. Such attributes reduced the time and increased conventional sessions' comfort, taking up to half an hour to about two to three minutes. Still, operations performed by laparoscopy can now be performed by robots, ensuring more excellent safety and precision. (5,8)

Navigation systems are also a new technique that allows intraoperative guidance to obtain greater accuracy in determining target lesions' resection margins. A robot-assisted system guided by interventional magnetic resonance imaging and a compatible endoscope is also considered to play an essential role in surgery. Likewise, nano-robots will accurately define and map cancerous tissue, providing the surgeon with accurate information about the target areas that require dissection. (5)

The outstanding research in molecular genetics and biology combined with the chemical-pharmaceutical industry's development has also made significant advances. However, the American Society of Clinical Oncology (ASCO) reported in the "Clinical Cancer Advances" that the refinement of surgical cancer treatment was the research area that showed

the most remarkable progress throughout 2019. According to ASCO, polishing the surgery and even avoiding it entirely in cancer treatment is crucial to rule out risks associated with an operation. Therefore, advances in chemotherapy treatments, targeted therapy, and immunotherapy allowed many people with cancer to have less invasive surgical procedures or even avoid surgery. (5)

## **6 SURGICAL APPROACHES IN ONCOLOGY**

### **6.1 PREVENTIVE**

This surgery, also called prophylactic, aims to reduce the chances of a possible tissue becoming cancer. The procedure may be performed even if there is no diagnosis or signs and symptoms at the surgery time. This surgery's indication involves the analysis of various criteria of risk analysis and benefit to the patient. Therefore, it should be very well evaluated and discussed between the doctor and the patient. (9–11)

In these cases, an entire organ can be removed if the patient presents a very high risk of developing the disease and having future complications. Generally, this pre-disposition is related to family history and genetic changes representing a greater likelihood of developing cancer in some regions. Among these changes, the mutations of BRCA, FAP (Familial Adenomatous Polyposis), and MEN (Multiple Endocrine Neoplasms) deserve a more excellent patient monitoring. (10)

A widespread prophylactic surgery is the one for patients with a high risk of developing breast cancer present, as risk factors, mutations in BRCA (1 or 2), strong family history, and histological risk factors. In these cases, a prophylactic mastectomy is considered (may be bilateral or unilateral), in which the withdrawal of all the breast tissue occurs in these patients, even if they do not yet have cancer or suspicious lesions. (10)

It is important to emphasize that preventive surgery serves to reduce the risk and possibility of cancer arising. However, it does not guarantee that the disease will not manifest once several other factors may influence a tumor's appearance. (10)

### **6.2 CURATIVE**

Curative surgery or primary surgery consists of removing a tumor with macro and microscopically-free surgical margins of injury. This approach can be performed in early tumors so as in locally advanced tumors and it corresponds to the largest number of indications in oncology surgery. In such operations, removal of the lymphatic drainage area (Lymphadenectomy) may also be necessary. (10,11)

The main surgical procedures with healing intent are local resection with margins, resection and lymphadenectomy (Monoblock or Diblock), multiple resections, amputations and disarticulations, and finally, resection and endoprosthesis. (10,11)

The treatment should always be chosen, considering several factors, such as the type of tumor, the location, the stage, and even each patient's choices and clinical conditions. (10,11)

### 6.3 DIAGNOSTIC

Surgery is a way to diagnose cancer. In many cases, the main or only way to know whether a person has cancer, and its histological type is by taking a tissue sample (biopsy) for laboratory analysis. Biopsy depends on factors such as the location of the tumor and the main suspicion of cancer. (11)

The most used types of biopsies for the diagnosis of cancer patients are:

1) Excisional and incisional biopsy: in the excisional biopsy, the surgeon performs the tumor's total withdrawal or the lymph node. However, in the incisional biopsy, it occurs the removal of only one fragment. Usually, these procedures occur with local or regional anesthesia, except for tumors located in the abdominal cavity and chest, in which case the procedure is performed under general anesthesia. (9–12)

2) Fine-needle aspiration biopsy (FNAB): a procedure performed through a fine needle and a syringe aspirating tumor cell and providing a cytological diagnosis. Imaging methods such as ultrasound or computed tomography can guide the needle to perform an aspiration biopsy. These methods are often used in situations where tumors are in deep and difficult regions to access. (9–12)

FNAB use is advantageous because an incision is not necessary, and in many cases, it is possible to perform the diagnosis on the same day of the procedure. The disadvantage is that the needle makes an aspirate and does not remove the tumor's fragments, providing a cytological diagnosis. This technique is commonly used in thyroid nodules and mammary cysts. (9–12)

3) Core needle biopsy (Core biopsy): in this technique, the needle has a larger caliber and size than that used in the FNAB. Tissue samples in this process can be 0.6 cm in diameter and 1.2 cm in length, and the procedure is performed in ambulatories with local anesthesia. One disadvantage is that the collected material's analysis takes longer than the processing of the FNAB samples. The great advantage is that this biopsy provides a histological diagnosis, usually with the tumor type, being the preferred technique for diagnosing neoplasms. (9–12)



4) Endoscopic biopsy: in this situation, the endoscope is used to observe the inside of a cavity or viscera. In this examination, the doctor may also take a tissue sample. Depending on the tumor location surgeons can use a rhinoscope, a digestive endoscope, colonoscope or, a bronchoscope. (9–12)

5) Biopsy by laparoscopy, thoracoscopy, and mediastinoscopy: these procedures are minimally invasive surgeries and require incisions, with the introduction of optical systems to evaluate the desired cavity. They are mainly indicated when other forms of biopsy cannot access the tumor or do not have good accuracy of the tumor site and assist tumor staging. During laparoscopy, the doctor can take samples and has the advantage of being able to look at the size of the affected area and the tissues around the lesion. This is very useful in peritoneal implants diagnosis, where there is a lack of accuracy by radiological exams. The procedure used to observe the thoracic cavity is called thoracoscopy. Mediastinoscopy is a technique made through a cervical incision to access mediastinal lymph nodes. (9–12)

6) Biopsy by Laparotomy and Thoracotomy consists of the realization of an incision in the abdominal cavity (laparotomy) or chest (thoracotomy). It is recommended when the least invasive mechanisms cannot access the area damaged by cancer, and the procedure is done through general anesthesia. Fortunately, these procedures have been gradually decreased over the years. (9–12)

7) Sentinel lymph node biopsy: this procedure is ubiquitous and essential because it can diagnose cancer spread to the lymph nodes. Thus, this procedure helps to know which lymph ganglion should be removed for biopsy and subsequently analyzed. (9–12)

These lymph nodes are called sentinel once they are the first place where cancer begins to spread. The doctor injects a radioactive material to the sentinel lymph node and locates this lymph node through scintigraphy before surgery. In the surgical moment, another technique that consists of injecting blue dye patent peritumoral may be associated. After this, an incision will be made in the skin to find this identified lymph node, and then it is removed and analyzed under the microscope. It is concluded that if the sentinel lymph node does not have cancer cells, it will not be necessary to remove the region's remaining lymph nodes. However, if there are cancer cells, it will be necessary to remove all lymph nodes from the site, indicating a greater likelihood that cancer has spread to these nodes. This type of analysis is prevalent in cases of melanoma and breast cancer. (9–12)

Early detection of a tumor is crucial because it makes the treatment more effective, increases the chances of healing, and improves the patient's quality of life. For this reason, this step is of extreme relevance to inpatient care. (9–12)

#### 6.4 STAGING

Surgery adds essential information to tumor staging, as it is possible to perform biopsies, check for the invasion of adjacent structures, and analyze the spread of the disease. During the procedure, it is also possible to see if the lymph nodes were affected. The primary surgeries used are mediastinoscopy, laparoscopy, and laparotomy. They are essential to guide decisions about treatment and the patient's prognosis. (11)

#### 6.5 DEBULKING

In these surgical procedures, only a part of the tumor is removed. Generally, the tumor's total removal would cause more damage to the patient and could injure nearby organs and tissues. Partial resection is not the ideal procedure. Complete resection should always be preferable. In this situation, it is widespread to use neoadjuvant therapy, such as chemotherapy or radiation therapy administered before surgery, which reduces the size or extension of the tumor. (10)

When it is not possible to have a complete resection surgery, the patient is submitted to chemotherapy or radiotherapy treatment. Later, a new surgery has to be done, as in ovarian tumors. (11)

#### 6.6 PALLIATIVE

In situations where the cancer is at a very advanced stage, and there is no prediction of a possible cure for the patient, palliative surgeries are used. These procedures relieve the symptoms and complications caused by the tumor, aiming to improve patients' quality of life. It is worth mentioning that these surgeries are not able to cure or treat the tumor. They usually are useful in removing the patient's pain, bleeding, and solving obstructive frames, hygienic purpose, and endocrine ablation, bringing comfort and improving the patient's quality of life. (10,11)

#### 6.7 RECONSTRUCTION

Reconstructive surgery is performed to improve patients' appearance and to restore the function of an organ or part of the body after some radical or invasive procedure. These surgeries are widely used in people who have had breast cancer and had to undergo a mastectomy. In these procedures, tissue flaps, bone grafts, and even prosthetic materials can be used. (10)

## 6.8 SUPPORTIVE

Supportive surgeries are performed to facilitate the patients' access to other therapeutic options, as catheter insertion for chemotherapy administration or tube feedings like gastrostomy. (10)

## 7 SURGICAL TECHNIQUES IN ONCOLOGY

### 7.1 LAPAROSCOPY

Even though this procedure had already been described in the 20th century, the laparoscopic access route has gained tremendous visibility recently. The evolution of specialized materials that allow minimally invasive approaches, leading to less surgical trauma, less pain in the postoperative period, in addition to a reduction in hospital stay with faster patient recovery, contributed to the therapeutic success. Laparoscopy can be used as a diagnostic and therapeutic surgical method that identifies hidden diseases and helps in the specific therapeutic decision. (10)

In this procedure, the patient is submitted to general anesthesia and, after the injection of carbon dioxide to expand the abdominal cavity and better view of the organ, a laparoscope (a thin and flexible tube) is inserted into the patient through a small surgical incision to visualize precisely inside the body. Tweezers, scissors, staplers, and sutures are passed through other small holes, 0.5 to 1.5 cm in the abdominal cavity, passed through a trocar. This instrument has a cutting edge protected by an automatic retractable tip that, when passing the peritoneal cavity, has protection released to protect intra-abdominal organs. (13–16)

There has been controversy in oncology regarding laparoscopy performance in the treatment of tumors of the gastrointestinal tract. However, it is known that this procedure does not alter the cure rates in oncological terms at all. Besides, it allows the use of other associated technologies such as laparoscopic ultrasound. When secondary lesions are identified during laparoscopy, biopsies with sufficient biological material for histological diagnosis should be performed to search for molecular markers. (10)

This type of surgery allows a lower number of postoperative complications with earlier adjuvant chemotherapy administration, resulting in better patient clinical conditions. Laparoscopy contributes to patients' better tolerance to secondary treatments that also guarantee greater chances of effectiveness. (10,15)

When imaging methods guide laparoscopy, the procedure is more accurate. Esophageal cancer in the distal third or cardia (level of evidence III) staging with laparoscopy in the face of imaging tests has 88% sensitivity, 100% specificity, 96% accuracy and makes hidden

diseases evident in approximately 33% of patients. Squamous cell carcinoma of the esophagus upper third did not change their behavior after this procedure. The use of laparoscopic ultrasonography also improves patients' staging with lymph node involvement (mainly lymph nodes of the hepatoduodenal ligament and celiac trunk are affected). (10)

A laparoscopy is a crucial tool in patients with gastric cancer, as it helps in the correct staging. Patients with a T3 / T4 tumor or with positive lymph nodes benefit from neoadjuvant, with laparoscopy being the best method available to assess the serosa's involvement and the invasion of adjacent tissues. Patients with pancreatic cancer (level of evidence II) and hepatocarcinoma (level of evidence III) can use laparoscopy to understand the need to modify the treatment's staging and nature. Thus, this procedure can prevent laparotomy. (10)

In the cryopreservation of ovarian tissue, to preserve fertility in women at risk of failure in reproductive functions, the collection can occur via laparoscopy. Still, on gynecological tumors, laparoscopy can also be used as a route of choice to treat endometrial carcinomas based on total abdominal hysterectomy and bilateral salpingo-oophorectomy. Not only, but endometrial cancer surgeries also have the characteristic of low blood loss and a low number of transfusions necessary during the procedure when compared to open surgery when using laparoscopic surgery associated with robotics. (10,16)

Nephroureterectomy surgery can also use laparoscopy, either open or combined. However, when there is renal and ureteral dissection, laparoscopy becomes the most frequent choice. (10)

Despite the great benefits of this technique, it is not without complications. The most worrying among them, which occurs later and in about 0.8% of cases, is the trocar's introduction port's recurrence. Other more relevant ones are related to the cavity's access with a *Veress needle* for the pneumoperitoneum performance - that can unfold in subcutaneous emphysema, hematomas at the trocar point, ascites, or hernia leak in the trocar port, hollow visceral perforation, and vascular injury by the electric scalpel. (10)

Even though the visualization systems are better in this procedure, the surgeon's ability can be a complicating factor during complex procedures; since laparoscopic movements occur in three dimensions and are based on the optics' two-dimensional movements, only four degrees of movements are allowed to surgery performance. (10)

## 7.2 ROBOTIC SURGERY

Robotic systems were created to improve the concept of minimally invasive surgery. In 1994, in the United States, the first robotic system for use in the surgical field called the

*Automated Endoscopic System for Optimal Positioning*™ was created. It consisted of a mechanical arm that held the laparoscopic optics controlled by the surgeon using pedals or voice commands, with the advantage of eliminating undesirable movements and ease in producing complex movements to be performed by the operator. (10)

In Belgium, in 1997, the first robotic cholecystectomy was performed by *Intuitive Surgical's da Vinci*®. This system allowed more excellent surgical dexterity since it was formed by a surgical console that controls an automated tower composed of three surgical arms and the arrangement of several clamps, which act as the surgeon's hand. The robotic arms move in three axes, in addition to the binocular camera that transmits three-dimensional (3D) images with high definition. (10)

Currently, the *da Vinci Surgical System*® equipment is the most used for robotic surgery worldwide because it has a fourth robotic arm that allows the surgeon to manipulate three 5 mm surgical clamps and the camera in the abdominal cavity, allowing less trauma to the abdominal wall. It is approved by the *Food and Drug Administration* (FDA) and the *Agência Nacional de Vigilância Sanitária* (ANVISA) to perform cardiological, gastrointestinal, urological, gynecological, and general surgery procedures. Although this procedure has many advantages such as the enlarged 3D view (especially in the more splendid view of lymphadenectomies), better hemostasis, more outstanding ergonomics in performing the procedure, and elimination of the tremor together with involuntary movements, the negative aspect appears related to the high cost, especially for the Brazilian project, and the complex assembly of the system in the initial stages of installing the program. (10)

Regarding the estimated blood loss, the meta-analysis data shows a non-significant difference between robotic and laparoscopic surgery. Another comparison between these two types of surgery is the relationship between hospital stay length after surgery; robotic surgery patients had a shorter or similar time with faster recovery. (17)

Robotic surgery can be used to treat colon and rectal cancer. The improved visualization systems allow preserving the pelvic autonomic nerves, improving the harvested lymph nodes' dissection, and the vessels' ligature accuracy. (17)

In head and neck surgery, cervical lymphadenectomy can use retro auricular approaches (in cervical lymphadenectomy) for the deep neck and compartments and perform transpalatal approaches (to treat nasopharyngeal carcinoma and access the anterior base of the skull) by extremely graceful movements and dissections. Metastatic retropharyngeal nodules can be removed with low morbidity during the surgical procedure through transoral access. The

thyroidectomy may be performed by the access trans-axillary, bypassing the existence of visible scars. (18)

Colectomies, rectosigmoidectomies, duodenopancreatectomies, and prostatectomy can also benefit from robotic surgery systems. In esophagectomies, the system allows the surgeon to work in a narrow space such as the mediastinum (with instruments 7.5 cm longer than laparoscopic instruments), overcoming the space limitation of laparoscopic or thoracoscopic surgeries. Robotic procedures are also considered safe for gastrectomy and lymphadenectomy. (10)

Robotic, promising, and safe surgery does not exclude the existence of open or laparoscopic surgery in cancer treatment, but it can allow considerable help in the treatment of cancer patients. (10)

### 7.3 MOHS MICROGRAPHIC SURGERY

Mohs Micrographic Surgery was developed by Frederich Mohs, at the University of Wisconsin, in the 1930s. This surgery has an excellent cure rate in primary (98 - 99%) and recurrent (95 - 96%) skin tumors. (10)

This technique consists of removing the tumor with a small margin. Afterward, the surgical specimen must be frozen simultaneously for full visualization of the lateral and deep margins. If a tumor remains on any of the edges, a new excision is performed with the smallest possible margin, which will also be frozen and prepared for microscopic examination. This step is repeated until there are complete tumor resection. (10,19)

Mohs Micrographic Surgery allows a better evaluation of the surgical margins, in addition to a better aesthetic result due to less removal of viable tissue that surrounds the tumor. This surgery is indicated when the extent of the disease is unknown or necessary to preserve healthy tissues, especially in the treatment of skin cancer close to the eyes. (10,19)

It can also be performed in pre-invasive, superficial, and low-grade lesions, such as carcinoma in situ, penile preservation procedures when there is penile carcinoma, and sclerodermiform basal cell carcinoma. (10)

### 7.4. RADIOFREQUENCY ABLATION

Radiofrequency ablation (RFA) uses low voltage contact electrodes to promote heating and death of cancer cells. In terms of image-oriented interventions, this technique allows oncological patients to acquire curative treatment by a radiologic intervention, open incision, or via laparoscopy. (19,20)

Hepatocarcinoma patients with liver cirrhosis, portal hypertension, or other severe comorbidities may be submitted to RFA. In this procedure, a needle is directed to the liver injury (using computed tomography or ultrasound scan as a guide). When the ideal position is found, a generator discharges a fast-alternating electric current at the tip of the needle. The radiofrequency energy allows the friction of water molecules and ionic components at a temperature of 55 to 60 ° C, which generates liquefactive necrosis of the tumor. In osteoma-selected patients, RFA can be associated with intra-arterial chemoembolization, as it reduces the degree of tumor vascularization, reducing energy dissipation to nearby vessels. (10,19)

RFA may also be used in patients who need liver transplants. In Brazil and some countries, patients who do not meet the Milan criteria (single liver lesion up to 5 cm or up to 3 lesions up to 3 cm each) may be submitted to RFA to reduce their lesions' size, allowing the transplantation performance. Patients with neuroendocrine tumors can also use RFA as a palliative treatment for symptoms caused by hormonal excess. About 69 to 80% of patients have improved symptoms and survival rates after RFA. (10)

Breast Cancer Metastases patients may benefit from RFA treatment. A study carried out by Livraghi et al. in 2015 with 24 patients showed that RFA improved in 58.6 months the average survival from the moment of the intervention and showed a 25% chance of local tumor progression as well as a 53% chance of developing new tumor lesions. Thus, despite the high rates of recurrence, the study concluded that ovaries RFA might be efficacious in the systemic treatment of breast cancer. This technique can also be used in patients with kidney lesions and primary lung injury during lung cancer. (10,21)

In general, RFA is a procedure with low rates of morbidity and mortality. However, severe complications are related to liver failure, number and size of lesions, electrode type, and surgeon experience. About 40% of patients have post-ablation syndrome from 24 to 48 hours following RFA and lasts no longer than ten days. This Syndrome is characterized by low fever (up to 38°C), discomfort, malaise, nausea, fatigue, and prostration, due to cytokine release and tumor necrosis. RFA technique may become limited in some cases due to the inability to accurately assess treatment margins in three dimensions. (10)

## 7.5 OTHER SURGICAL TECHNIQUES

Laser surgery, electrosurgery and cryosurgery are surgical techniques that were used in oncology scenario. However, they are no longer indicated for this purpose once the other techniques mentioned in this review were shown to be safer and more effective. (10,22)

## 8 CONCLUSION

Oncological Surgery is one of the main pillars of cancer treatment, with a significant evolution over the years. The mentality of a minimally invasive surgery performed mainly with video laparoscopy, and robotic surgery techniques revolutionized cancer treatment, increasing the possibility of cure and patients' survival time. Although access to these techniques is not uniform worldwide, the trend is that, in the coming years, there will be an increase in their popularization.

In recent years, oncology has observed new studies based on chemotherapies and radiotherapies regimens that are increasingly effective along with the emergence of target therapies, gene therapies, and immunotherapies as very promising therapies. Surgery has assumed an adjuvant role being used in association with these other treatments.

In the oncological scenario, surgeries are indicated for prevention, diagnosis, disease spread assessment, curative treatment, sequelae and complications management, as well as palliation. The oncological surgeries are available in a wide variety of techniques, each with its particularities. Knowledge of its applicability, different techniques, and future expectations is essential for the correct orientation, referral to specialists, and patients' follow-up.



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