ISSN 2616-5791 Vol.4, Issue 10: 61-65, DOI: 10.25236/AJMHS.2023.041010

Surgical Management of Thyroid Nodules: Current Trends and Future Perspectives

Yuekun Yin

Kyungwoon University, Gumi, Korea

Abstract: *Thyroid nodule refers to the pathological changes caused by abnormal proliferation of thyroid cells, and its surgical treatment has a long history and has always been regarded as an effective means to treat this disease. With the continuous development and progress of medical technology, the surgical treatment of thyroid nodules is also evolving to better meet the needs of patients and improve the treatment effect. As far as the current trend is concerned, the surgical treatment of thyroid nodules mainly focuses on refinement, minimally invasive and personalization. Among them, refined surgery refers to the use of advanced instruments and equipment, such as ultrasonic scalpel, bipolar electrocoagulation, etc., which can more accurately separate and remove diseased tissues, reduce the damage to normal tissues, and improve the surgical effect and postoperative recovery speed. Minimally invasive surgery refers to the use of various minimally invasive techniques, such as endoscope and robot, to reduce surgical trauma and risk, reduce postoperative pain and recovery time. Personalized surgery refers to adopting different surgical methods and techniques according to the specific conditions and needs of patients to achieve the best therapeutic effect. Looking forward to the future, there is still much room for the surgical treatment of thyroid nodules. With the continuous progress of medical technology and the improvement of people's requirements for quality of life, surgical treatment of thyroid nodules will pay more attention to patients' quality of life, postoperative recovery and social adaptability. At the same time, with the continuous development of artificial intelligence, machine learning and other technologies, the surgical treatment of thyroid nodules will be more intelligent, accurate and individualized. Doctors can accurately evaluate and predict the patient's condition through artificial intelligence and other technologies, so as to formulate a more scientific and personalized treatment plan.*

Keywords: *Thyroid nodule, surgical treatment, future prospect and trend*

1. Introduction

Thyroid nodule refers to a lump or mass in thyroid tissue, which can be single or multiple, and can usually be diagnosed by imaging methods such as ultrasound. Although most thyroid nodules are benign, some will turn into malignant tumors. Because of the existence of malignant nodules, patients often face the problem of whether surgery is needed. In addition to the changes in surgical methods, the surgical indications for thyroid nodules are also expanding. In the past, only malignant nodules or benign nodules with obvious symptoms would be considered for surgical treatment, but now for some benign nodules with no symptoms but possible malignant transformation, surgical treatment can also be considered. In addition, for patients with advanced age, poor physical condition and other diseases, we can also choose appropriate surgical methods and timing through individualized treatment programs to obtain better treatment results. Of course, any operation has certain risks and complications, and thyroid nodule surgery is no exception. Common postoperative complications include bleeding, infection and recurrent laryngeal nerve injury. In order to reduce the incidence of postoperative complications, doctors need to make full evaluation and preparation before operation, understand the patient's specific condition and surgical history, and make detailed surgical plans and emergency plans. During the operation, doctors should strictly abide by the operation specifications, avoid unnecessary injury and bleeding, and improve the safety and effect of the operation[1-2].

2. The current trend

1) Progress in preoperative evaluation

Preoperative evaluation plays an important role in the operation process. With the continuous progress of medical technology, the preoperative evaluation method is also improving, so that doctors can predict

ISSN 2616-5791 Vol.4, Issue 10: 61-65, DOI: 10.25236/AJMHS.2023.041010

the patient's condition more accurately and make a more reasonable surgical plan. Ultrasound examination is a very common preoperative evaluation method. By ultrasonic examination, doctors can know the size, shape, location and adjacent relationship with surrounding tissues of nodules. In addition, doctors can also judge the benign and malignant nodules through ultrasound examination, thus guiding the scope of surgical resection. Thyroid function test is also an important part of preoperative evaluation. Through thyroid function test, doctors can know the level of thyroid hormone and other related indexes of patients, so as to judge the nature of nodules. For patients with thyroid dysfunction, doctors can control the patient's condition by adjusting the dosage of drugs, thus ensuring the smooth operation. Fine needle aspiration cytology is a very accurate preoperative evaluation method. Doctors can determine the nature of the nodule by using a fine needle to suck some cells of the nodule and then observing the morphology and structure of the cells under a microscope. This method is not only minimally invasive, but also accurate, which can provide important reference for doctors.

In a word, the progress of preoperative evaluation provides doctors with more accurate prediction methods and more perfect surgical plans, thus improving the success rate of surgery and the cure rate of patients. In the future development, with the continuous innovation and improvement of technology, the preoperative evaluation method will be more accurate and comprehensive, bringing better therapeutic effect and higher survival rate to patients.

2) Application of neural monitoring technology

Injury of recurrent laryngeal nerve is a common problem in thyroid nodule surgery. In order to reduce this risk, neural monitoring technology has been widely used. Nerve monitoring technology is a technology to guide surgical operation by monitoring nerve electrical activity. In thyroid nodule surgery, the electrical activity of recurrent laryngeal nerve can be monitored in real time by special equipment. Through this monitoring, doctors can know the position and direction of recurrent laryngeal nerve and its activity in the operation area. This kind of information is very important for the operation, because it can help doctors avoid damaging the recurrent laryngeal nerve. The application of nerve monitoring technology in thyroid nodule surgery has many advantages. First of all, it can improve the accuracy and effect of surgery. By monitoring the position and activity of recurrent laryngeal nerve in real time, doctors can judge the relationship between nodules and recurrent laryngeal nerve more accurately, thus avoiding unnecessary damage. Secondly, this technique can shorten the operation time and reduce postoperative complications. Because the operation is more accurate and targeted, the operation time can be greatly shortened and the incidence of postoperative complications will be reduced accordingly. In a word, the application of nerve monitoring technology is an important progress in thyroid nodule surgery. By monitoring the electrical activity of recurrent laryngeal nerve in real time, doctors can perform surgery more safely and effectively, bringing better therapeutic effect and higher survival rate to patients. In addition, this technology can be extended to other surgical fields to help doctors better protect the nervous system and other important organs[3-7].

3) Development of minimally invasive surgery

With the continuous progress of medical technology, minimally invasive surgery has become an important means to treat thyroid nodules. Compared with traditional open surgery, minimally invasive surgery has the advantages of less trauma, less pain and faster recovery, which greatly improves the postoperative quality of life of patients. There are many ways of minimally invasive surgery, among which endoscopic surgery and percutaneous papillary muscle endoscopic surgery are two commonly used. Endoscopic surgery is to establish a surgical channel in the natural cavity of the patient's body (such as oral cavity, nasal cavity, pleural cavity, etc.) and put the endoscopic probe deep into the thyroid gland for surgery. This kind of operation can not only reduce surgical trauma, but also avoid leaving scars on the skin surface and improve the aesthetics of patients. Percutaneous papillary muscle endoscopic surgery is to establish a surgical channel on papillary muscle and perform thyroid surgery through endoscope. This kind of operation can avoid the damage to normal tissues to the greatest extent, and at the same time, it can also perform fine surgical operations.

In addition to the above two commonly used minimally invasive surgical methods, there are some other minimally invasive surgical methods, such as ultrasound-guided thermal ablation and laser ablation. These surgical methods not only have the advantages of less trauma, but also can radically cure benign thyroid nodules and avoid recurrence. Minimally invasive surgery has been widely used in the treatment of thyroid nodules, which has the advantages of less trauma, less pain and quick recovery, and provides patients with safer and more comfortable treatment options. However, for some large or complex thyroid nodules, traditional open surgery is still a feasible and effective treatment. Therefore, when choosing the surgical treatment method, it is necessary to consider comprehensively according to the specific situation of the patient and the doctor's advice.

ISSN 2616-5791 Vol.4, Issue 10: 61-65, DOI: 10.25236/AJMHS.2023.041010

3. The future outlook

1) Individualized treatment

With the continuous progress of science and technology, especially in the field of gene sequencing technology, the future surgical treatment of thyroid nodules will be more individualized. This individualized treatment method will evaluate the patient's condition more accurately and provide more accurate surgical decision-making guidance. Gene sequencing technology is a method to extract information from patients' genes and analyze specific variations. Through this technology, doctors can deeply study the nature and origin of thyroid nodules, and at the same time understand the malignant risk of nodules. This allows doctors to make more targeted treatment plans according to the unique genetic variation of each patient.

Specifically, gene sequencing can help doctors determine whether nodules are single or multiple, and whether these nodules are hereditary. This information can help doctors to better evaluate the condition and make a suitable surgical plan for patients. For those nodules with high malignant risk, doctors can choose comprehensive surgical resection, while for those nodules with low risk or benign, doctors can choose more conservative treatment methods.

In addition, gene sequencing technology is also helpful to evaluate the therapeutic effect of patients after operation. By comparing the genetic changes of nodules before and after operation, doctors can judge whether the operation is successful or not and make a follow-up treatment plan. Generally speaking, the development of gene sequencing technology will make the surgical treatment of thyroid nodules more individualized. This individualized treatment method will evaluate the patient's condition more accurately, provide more accurate surgical decision-making guidance, and evaluate the treatment effect after operation. This will greatly improve the accuracy and effect of thyroid nodule treatment, and make patients get better treatment experience and higher[8-11].

2) Highly precise surgery

With the rapid development of science and technology, the progress of surgical technology and equipment makes the operation more accurate and safe. In thyroid nodule surgery, the introduction of robot-assisted surgery and augmented reality technology will further improve the accuracy and safety of the operation and reduce the occurrence of postoperative complications. Robot-assisted surgery is a highly accurate surgical operation technology. By using advanced robot system, doctors can achieve more precise and stable operation in surgery. This kind of operation can reduce the fatigue and hand trembling of doctors, improve the accuracy and stability of the operation, and thus reduce the incidence of postoperative complications. Augmented reality technology is a technology that combines virtual images with the actual situation of patients. Through this technology, doctors can obtain more accurate real-time image information during surgery, so as to better judge the location, size and shape of nodules and avoid damage to surrounding tissues. In addition, augmented reality technology can also combine the surgical navigation system with real-time image information to help doctors determine the scope of surgical resection more accurately, thus reducing the occurrence of surgical trauma and complications.

In a word, the introduction of robot-assisted surgery and augmented reality technology will make thyroid nodule surgery more accurate and safe. These techniques are helpful to improve the accuracy and safety of surgery, reduce the occurrence of postoperative complications, and bring better therapeutic effect and higher survival rate to patients. At the same time, the application of these technologies will also promote the development of surgery in a more intelligent and refined direction.

3) Improvement of postoperative management

The improvement of postoperative management will receive more attention in the future surgical treatment of thyroid nodules. Improvements in this area include standardized postoperative care and thyroxine replacement therapy, aiming at reducing the incidence of postoperative complications and improving the quality of life of patients. First of all, standardized postoperative care is very important for patients' rehabilitation. Postoperative care includes wound treatment, anti-infection measures and recovery exercise. Scientific and standardized nursing can reduce the risk of postoperative complications and accelerate the recovery of patients. In addition, patients need to pay close attention to and report any abnormal symptoms to the doctor in time after operation so as to deal with them in time. Secondly, thyroid hormone replacement therapy after thyroid surgery is also very important. After thyroid surgery, thyroxine secretion will be affected, which may lead to hypothyroidism or thyroxine deficiency. Thyroxine replacement therapy is to supplement the body's thyroid hormone level by taking thyroid hormone drugs orally to maintain the normal metabolic function of the body. Reasonable thyroxine replacement therapy can effectively control the thyroid function of patients, avoid the symptoms caused by hypothyroidism, and help prevent the recurrence of thyroid cancer. In addition, postoperative patients should also have regular thyroid function monitoring and ultrasound imaging examination. Regular

ISSN 2616-5791 Vol.4, Issue 10: 61-65, DOI: 10.25236/AJMHS.2023.041010

thyroid function test can find abnormal thyroid function in time and adjust the dose of thyroxine replacement therapy in time. Ultrasound imaging can be used to observe the residual thyroid tissue and monitor the changes of nodules, and to rule out the possibility of recurrence or metastasis after operation. Future postoperative management can also be combined with the application of intelligent medical technology, such as remote health monitoring and electronic health records.

These technologies can help patients to follow up and care after operation more conveniently and provide personalized medical advice and support. Future surgical treatment of thyroid nodules will focus on comprehensive postoperative management, including standardized postoperative care, thyroxine replacement therapy and regular thyroid function monitoring. At the same time, the application of intelligent medical technology will also bring convenience and personalized service for postoperative management. These improvement measures are aimed at reducing the incidence of postoperative complications, optimizing the recovery process of patients and improving their quality of life[12-13].

4. The surgical treatment of thyroid nodules encountered problems.

1) Benign and malignant identification problem

Thyroid nodules are a common clinical problem, with approximately 1% of the adult population being affected. Although most thyroid nodules are benign, a minority may be malignant. Correctly distinguishing between benign and malignant nodules is crucial, as treatment and prognosis vary significantly between the two categories. Currently, the differential diagnosis of thyroid nodules typically involves a combination of clinical examination, laboratory testing, and radiological evaluation. However, the accuracy of these tests is limited, and there is potential for both false-positive and false-negative results.

In recent years, there has been increasing interest in the use of circulating biomarkers—molecules found in the bloodstream that can indicate the presence of a particular condition or disease. The field of circulating biomarkers is still in its early stages, but preliminary research suggests that circulating miRNA and serum protein markers may have potential in distinguishing between benign and malignant thyroid nodules. Moving forward, further research is warranted to validate and refine these circulating biomarker assays. Additionally, there is a need for large-scale, prospective studies to determine the clinical utility of these markers in managing thyroid nodules.

2) Determination of the scope of operation

The surgical treatment of thyroid nodules is indeed controversial, and choosing the appropriate surgical method has an important impact on the therapeutic effect and prognosis. Although total resection can reduce the risk of recurrence and lymph node metastasis, partial resection can reduce operation-related complications and preserve normal thyroid tissue, so the size, shape, ultrasonic characteristics and fine needle aspiration results of nodules should be considered comprehensively when determining the scope of operation. In addition, possible complications during operation also need to be seriously considered and prevented. Although modern technology has reduced the incidence of surgical complications, it is still necessary to pay attention to the prevention and treatment of intraoperative complications in order to further improve the safety and effect of surgical treatment of thyroid nodules.

3) Intraoperative complications

Surgical treatment of thyroid nodules is a relatively common surgical procedure. Although modern technology has greatly reduced the incidence of surgical complications, there may still be some problems during the operation, such as vocal cord nerve injury, thyroid artery injury, cervical lymph node infection and so on. How to further reduce the incidence of intraoperative complications is still a problem to be solved.

4) Postoperative management and follow-up

Postoperative management and follow-up are very important for the rehabilitation and prognosis of patients with thyroid nodules. Including thyroxine replacement therapy, postoperative care, ultrasonic imaging examination and thyroid function monitoring. However, in practice, there are some problems in the quality and consistency of postoperative management and follow-up. How to improve the compliance of patients and the management level of doctors is a difficult problem that needs attention.

5. Conclusion

Surgical treatment of thyroid nodules has become a mature and effective treatment. At present, the trend of thyroid nodule surgery is developing towards individualization, minimally invasive and

ISSN 2616-5791 Vol.4, Issue 10: 61-65, DOI: 10.25236/AJMHS.2023.041010

precision. First of all, individualized treatment based on gene sequencing technology will be more deeply applied in thyroid nodule surgery. By analyzing the genetic variation of patients, we can better judge the malignant risk of nodules, so as to guide doctors to make more accurate surgical decisions and achieve cure with minimal trauma and highest accuracy. Secondly, with the development of robot technology, robot-assisted surgery and augmented reality technology will be more widely introduced into thyroid nodule surgery, making the operation more accurate and stable, improving the accuracy and safety of the operation and reducing the occurrence of postoperative complications. In addition, postoperative management will become more important.

Through postoperative management and rehabilitation, we can ensure the rapid recovery of patients and find and deal with possible complications in time. In a word, with the continuous progress of medical technology, surgical treatment of thyroid nodules will bring better therapeutic effect and quality of life to patients. The surgical treatment of thyroid nodules is one of the hot spots at present, and its therapeutic effect and patient satisfaction have been continuously improved. With the continuous development and progress of medical technology, it is believed that the surgical treatment of thyroid nodules will usher in a better future.

References

[1] Rabi Larissa Teodoro, Peres Karina Colombera, Nascimento Matheus, de Souza Teixeira Elisangela, de Freitas Leandro Luiz Lopes, Barreto Icléia Siqueira, Geraldo Murilo Vieira, Assumpção Lígia Vera Montalli, Máximo Valdemar, Tincani Alfio José, Bufalo Natassia Elena, Ward Laura Sterian. Investigation of the clinical utility of adhesion molecules in the management of thyroid nodules. [J]. Scientific reports, 2023, 13(1).

[2] Albano Domenico, Treglia Giorgio, Dondi Francesco, Giubbini Raffaele, Galani Alessandro, Cappelli Carlo, Bertagna Francesco, Casella Claudio. Comparison between total thyroidectomy and hemithyroidectomy in TIR3B thyroid nodules management. [J]. Endocrine, 2022, 78(2).

[3] Karatay Emrah, Javadov Mirkhalig, Kartal Kinyas. The Efficacy of ACR TI-RADS in the Management of Suspected Thyroid Nodules and Its Correlation with the Bethesda Scoring System [J]. Journal of Diagnostic Medical Sonography, 2022, 38(4).

[4] Adem Akçakaya. Current Status of Approach to Thyroid Nodules [J]. Bezmialem Science, 2022, 10(2).

[5] Sag Alan A., Kazaure Hadiza S., Kelley Carly. Role of Thyroid RFA in the Treatment of Autonomously Functioning Thyroid Nodules [J]. Techniques in Vascular and Interventional Radiology, 2022, 25(2).

[6] Levent Gürbüzler. The Role and Importance of Molecular Tests in Approach to Thyroid Nodules [J]. Turkish Archives of Otorhinolaryngology, 2016, 54(2).

[7] Tahmasebi Natasha, Farwana Mohammad, Mushtaq Amina, Tornari Chrysostomos, MacNeill Morna, Li Lucy, Nixon Iain, Simo Ricard. P-195 A two-centre review of the management of cytologically suspicious thyroid nodules for Malignancy (Thy 4) [J]. Oral Oncology, 2021, 118(S).

[8] Novizio R. The emergence of minimally-invasive procedures as a treatment for Thyroid Nodules. [J]. Journal of Critical Reviews, 2020, 7(17).

[9] Shidlovskyy A. V. Choice of Thyroid Nodules Treatment [J]. Galician Medical Journal, 2016, 23(3).

[10] Tarashchenko Yu. M., Kovalenko A. E., Ostafiychuk M. V., Yanchii I. R., Melnyk M. D., Zelinskaya G. V., Naida Yu. M. Surgical treatment of the thyroid nodes of uncertain cytological structure [J]. Klinicheskaia khirurgiia, 2019, 86(5).

[11] Kardelen Al A D, Yılmaz C, Poyrazoglu S, Tunca F, Bayramoglu Z, Bas F, Bundak R, Gilse Senyurek Y, Ozluk Y, Yegen G, Yeşil S, Darendeliler F. The Role of Thyroid Fine-Needle Aspiration Cytology in the Treatment and Follow-Up of Thyroid Nodules In The Pediatric Population. [J]. Acta endocrinologica (Bucharest, Romania: 2005), 2019, 15(3).

[12] Hye Sun Park, Younghee Yim, Jung Hwan Baek, Young Jun Choi, Young Kee Shong, Jeong Hyun Lee. Ethanol ablation as a treatment strategy for benign cystic thyroid nodules: a comparison of the ethanol retention and aspiration techniques [J]. Ultrasonography, 2019, 38(2).

[13] Gamme Gary, Parrington Tyler, Wiebe Edward, Ghosh Sunita, Litt Brendan, Williams David C, McMullen Todd P W. The utility of thyroid ultrasonography in the management of thyroid nodules. [J]. Canadian journal of surgery. Journal canadien de chirurgie, 2017, 60(2).