

Robotic Surgery - The Future Otorhinolaryngology Normal

Sathapan Manimeyapan S Palaniappan (MBBS MRCS-ENT)¹, Ahmad Kusyairi Khalid (BMedSc MB BCH BAO MS ORL-HNS)^{1,2}, Sahrir Sanusi (MD MS ORL-HNS)¹

¹Department of Otorhinolaryngology- Head & Neck Surgery, KPJ Healthcare University, Nilai, Negeri Sembilan

²Department of Otorhinolaryngology- Head & Neck Surgery, UITM Private Specialist Centre, Jalan Hospital, Sungai Buloh, Selangor

Abstract: Robotic surgery, specifically Transoral Robotic Surgery (TORS), is gaining traction for treating vallecular cysts, offering enhanced precision and visualization, and potentially a less invasive approach compared to traditional methods. Vallecular cysts, also known as epiglottic mucus retention cysts or base of tongue cysts, are benign retention cysts that arise when the duct of a mucous gland or lingual tonsillar crypt becomes obstructed and dilates. A 6 years old girl presented with noisy breathing and dysphagia. A contrasted tomography neck scan revealed a vallecula cyst. Child presented, 6 months ago with similar presentation and was operated under conventional method. Histopathology revealed non-malignant vallecula cyst. The dilemma was either to choose between the conventional method or to go for a robotic surgery. In view of recurrence, TORS was offered because it had better access and reach for complete excision.

Keywords: robotic surgery, TORS, vallecular cyst, pediatric otorhinolaryngology, minimally invasive

1. Introduction

TORS provides 3D magnified visualization of the pharynx and larynx, allowing surgeons to see the cyst and surrounding tissues with greater clarity¹. The robotic instruments offer tremor filtering and motion scaling, enabling surgeons to perform delicate procedures with greater accuracy². TORS can offer a less invasive approach compared to the conventional surgery, leading to faster recovery times and reduced scarring³.

2. Case Presentation

A 6 years old child, female with no comorbid but with previous history of surgery presented with noisy breathing mainly during sleep and dysphagia for 4 months. Child underwent tonsillectomy and excision of vallecula cyst done under conventional method at the age of 5. No episodes of cyanosis or shortness of breath. During the previous surgery, histopathology of the tonsils revealed bilateral chronic tonsillitis with reactive lymphoid hyperplasia, whereas vallecula cyst revealed benign fibromuscular tissue. Child was on follow-up since the previous surgery in view of recurrence. Recurrence was noted 1 month post operatively but remained asymptomatic at initial follow-ups.

On examination, she was alert and conscious. All vitals were normal. Upon examining, of the neck no obvious neck swelling noted. Rigid telescopic endoscopy (45°) revealed mass over the vallecula region. Clinically the size of the cyst was 1x1cm, smooth surface not fully obstructing the airway (Figure 1). All other findings were unremarkable. Blood parameters were normal. A contrasted Computed Tomography (CT) neck, reported there is a cyst at the vallecula region measuring 1.2x0.8cm. No other abnormalities noted (Figure 2,3).

Child was than referred for TORS after having a detailed discussion on the benefits of robotic surgery. Post operatively, child's recovery was uneventful and is free from

complications with no recurrence or residual (Figure 4,5,6). Histopathology revealed benign cystic lesion, negative for dysplasia or malignancy.

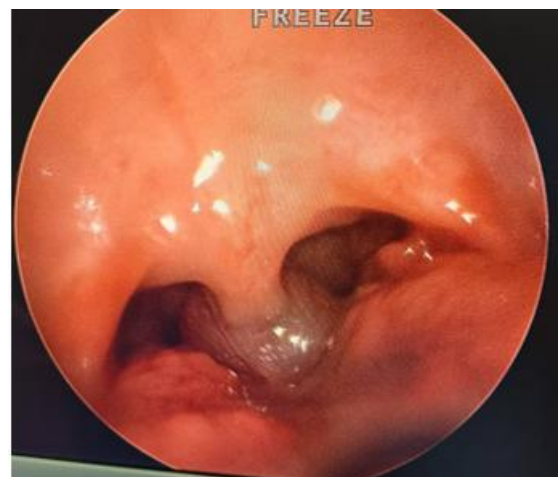


Figure 1: Rigid telescopic endoscope view, showing mass over the vallecula region measuring 1x1xm.

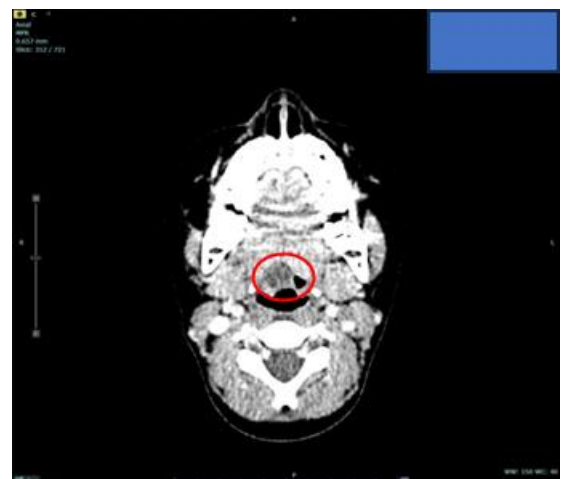


Figure 2: CT image axial view, showing a well- rounded cyst over the vallecula region.



Figure 3: CT image sagittal view, showing a well-rounded cyst over the vallecula region, sparing the airway.



Figure 6: Rigid telescopic endoscope view, post operatively which show no recurrence and well healed mucosa.



Figure 4: Transoral Robotic Surgery view, showing cyst at the vallecula region



Figure 5: Image of the complete cyst, postoperatively

3. Discussion

Robotic surgery is becoming more common for treating various diseases in different body parts². Trans-oral robotic surgery (TORS) is most commonly performed with the Da Vinci Surgical System, but the growing interest in robotic surgery has led to the development to improve surgical exposure and overcome anatomical limitations^{4, 11}.

Robotic surgery has established itself in the head and neck, despite the limitations of the surgical field. TORS is most commonly used for tumours of the tonsils, base of the tongue, vallecula, and larynx. In response to its advantages in precision, TORS has also gained popularity for benign diseases where functional and cosmetic effects are important; hence, avoiding more invasive procedures^{2, 11}.

Vallecula cysts are more common in newborns but can also occur in adults⁵. Although some people have a foreign body sensation when swallowing and sleep obstruction, it is usually asymptomatic. Complete excision is the preferred course of action in these situations since any cyst residual wall that causes re-accumulation is likely to reoccur. In contrast to using a robot, the open method has a higher recurrence rate⁶.

In 2005, McLeod and Medler performed the first head and neck robotic surgery, removing a vallecular cyst from the oropharynx. In fact, the literature has characterised the oropharynx as the most frequently treated area for TORS⁷. There have been reports of robotic surgery being used to treat various illnesses at this sub-site, and multiple meta-analyses have demonstrated the procedure's effectiveness in treating obstructive sleep apnoea syndrome (OSAS). The robot is specifically used to perform palatine tonsillectomy, epiglottoplasty, midline glossectomy, and lingual tonsillectomy to ensure adequate airflow^{7, 11}.

Robotic surgery can treat OSAS and associated consequences, such as velopharyngeal stenosis through pharyngeal flap transposition⁸. Trans-oral robotic excision of tongue-base ectopic thyroid has been described in several studies. Trans-oral lingual thyroglossal cyst excision is an alternative to Sistrunk. TORS can also treat salivary duct fistulas at the posterior tonsillar pillar, tongue base schwannomas and vascular lesions, and foreign bodies in the

lingual tonsil. Despite the apparent anatomical access constraints, TORS may be useful in children since OSAS and thyroglossal cysts and ectopic thyroids are congenital disorders². TORS can treat benign and malignant lesions of the palate, palatine tonsils, base of the tongue, posterior and lateral pharyngeal walls, parapharyngeal space, larynx, and hypopharynx². Contraindications include reduced mouth opening, incomplete lesion visualisation, mandible involvement, tumours involving >50% of the base or posterior wall, internal carotid artery, or prevertebral fascia⁹.

TORS development and implementation are progressing due to technological advances and increased interest in this new technology. This technology has many benefits, including the robotic system's magnification and ultra-high-definition camera, which improve surgical field visualisation; three-dimensionality, which improves depth perception of anatomical structures and their relations; efficient four-handed surgery; and motion scaling and tremor filtration, which avoids dangerous movements and allows precise tissue dissection and great access for complete excision^{2,7,12}.

However, several impediments hinder TORS propagation. First, the cost of the instrumentation can affect its rationale and accessibility to the robotic system. However, the global spread of this technology could potentially reduce its expensive costs, thereby enabling its widespread use. Furthermore, the shortage of head and neck surgical equipment can slow the transition to robotic surgery. Moreover, using a robotic technique can lengthen surgical durations, notably during setup and docking, although research indicates that its impact is minor and can be minimised with experience. Surgeons may benefit from simulator and hands-on cadaveric training for this novel method. Collecting cases in tertiary centres may improve therapeutic outcomes. Finally, single-port systems and other robotic surgery innovations are simplifying procedures and making them easier to handle².

Traditional open procedures need external incisions and extensive dissection of unaffected anatomical systems. Open surgery has substantial complications and long-term morbidity. TORS may minimise disfiguring mandibulotomy, eliminate the need for adjuvant radiotherapy and/or chemotherapy and tracheostomy/gastrostomy, enhance speech and swallowing, and reduce blood loss and postoperative pain compared to open surgery. Reduced scarring, wound infection risk, hospital stays, and recovery times may improve patients' quality of life. However, tumour localisation, size, initial biopsy, and neoplasia involvement of neighbouring structures determine surgical technique¹⁰.

A surgeon's console, a four-armed patient-side robotic cart, and a high-definition three-dimensional vision cart make up the Da Vinci Surgical System. Robotic arms with articulating surgical instruments are delivered into the upper aerodigestive tract through the patient's mouth and controlled remotely by master robot manipulators from the surgeon's console. Head and neck surgery uses only three arms: one to hold a 12-mm stereoscopic endoscope at 0° or 30° and the other two with 5-mm endo wrist instruments¹¹.

In 2006, O'Malley et al. reported a prospective clinical trial of TORS in three tongue base cancer patients. They reported good visualisation and tumour elimination. All three instances had complete resection with negative surgical margins and excellent control of bleed. No intraoperative or postoperative problems occurred¹³.

Da Vinci robots have been used for tongue base biopsy of unknown head and neck primary tumours. Metha et al. retrospectively studied ten individuals with unknown head and neck primary tumours. All patients underwent a cervical biopsy, positron-emission tomography/computed tomography, formal endoscopy, bilateral tonsillectomy, and transoral robotic base of tongue resection. Robot-assisted base of tongue excision found 90% of primary tumours with low morbidity⁷.

4. Conclusion

Overall, robotic surgery offers minimally invasive access and reach towards difficult areas in the oropharynx, avoiding open surgery for the patient. TORS is a safe and effective treatment for upper aerodigestive tract tumours, and its continued use and development are evolving; hence, it can benefit our patients more.

References

- [1] Dubey, S. P., Molumi, C. P., & Swoboda, H. (2020). Robot surgery. In *Springer eBooks* (pp. 449–459). https://doi.org/10.1007/978-3-030-29809-8_13
- [2] Cammaroto, G., Stringa, L. M., Zhang, H., Capaccio, P., Galletti, F., Galletti, B., Meccariello, G., Iannella, G., Pelucchi, S., Baghat, A., & Vicini, C. (2020). Alternative Applications of Trans-Oral Robotic Surgery (TORS): A Systematic review. *Journal of Clinical Medicine*, 9(1), 201. <https://doi.org/10.3390/jcm9010201>
- [3] Bekeny, J. R., & Ozer, E. (2016). Transoral robotic surgery frontiers. *World Journal of Otorhinolaryngology - Head and Neck Surgery*, 2(2), 130–135. <https://doi.org/10.1016/j.wjorl.2016.05.001>
- [4] Troise, S., Arena, A., Barone, S., Raccampo, L., Salzano, G., Abbate, V., Bonavolontà, P., Romano, A., Sembronio, S., Robiony, M., Califano, L., & Orabona, G. D. (2024). Transoral robotic surgery in Maxillofacial Surgery: systematic review of literature on current situation and future perspectives. *Current Problems in Surgery*, 61(8), 101504. <https://doi.org/10.1016/j.cpsurg.2024.101504>
- [5] Berger, Gilead & Averbuch, Eran & Zilka, Keren & Berger, Rachel & Ophir, Dov. (2008). Adult vallecular cyst: Thirteen-year experience. *Otolaryngology--head and neck surgery: official journal of American Academy of Otolaryngology-Head and Neck Surgery*. 138. 321-7. 10.1016/j.otohns.2007.12.008.
- [6] Cadena, E., Guerra, R., & Pérez-Mitchell, C. (2017). Bilateral vallecular cyst: transoral robotic resection. *Journal of Robotic Surgery*, 12(2), 369–372. <https://doi.org/10.1007/s11701-017-0733-x>
- [7] Rinaldi, V., Pagani, D., Torretta, S., & Pignataro, L. (2016).

- ecancermedalscience. *Ecancermedalscience*. <https://doi.org/10.3332/ecancer.2013.359>
- [8] Cammaroto, G., Stringa, L. M., Cerritelli, L., Bianchi, G., Meccariello, G., Gobbi, R., Iannella, G., Magliulo, G., Zhang, H., Baghat, A. Y., Galletti, F., Pelucchi, S., Stomeo, F., Younes, M. B., AlAjmi, M., De Vito, A., & Vicini, C. (2020). Acquired nasopharyngeal stenosis correction using a modified palatal flaps technique in obstructive sleep apnea (OSA) patients. *International Journal of Environmental Research and Public Health*, 17(6), 2048. <https://doi.org/10.3390/ijerph17062048>
- [9] The Royal Australian College of general Practitioners. (n.d.). *Trans-oral robotic surgery in oropharyngeal carcinoma – A guide for general practitioners and patients*. Australian Family Physician. <https://www.racgp.org.au/afp/2017/january-february/trans-oral-robotic-surgery-in-oropharyngeal-ca-3>
- [10] Kim, W. W. (2020). Transoral thyroidectomy: Advantages and disadvantages. *Daehan Nae'si 'gyeong Bog'gang'gyeong Oe'gwa Haghoeji/Journal of Minimally Invasive Surgery*, 23(3), 112–113. <https://doi.org/10.7602/jmis.2020.23.3.112>
- [11] Lefor, Alan. (2019). Robotic and laparoscopic surgery of the pancreas: an historical review. *BMC Biomedical Engineering*. 1. 10.1186/s42490-019-0001-4.
- [12] *Robotic surgery - Mayo Clinic*. (n.d.). <https://www.mayoclinic.org/tests-procedures/robotic-surgery/about/pac-20394974#:~:text=Robotic%20surgery%20allows%20doctors%20to,it's%20used%20in%20open%20surgeries>
- [13] Hans, S., Delas, B., Gorphe, P., Ménard, M., & Brasnu, D. (2011). Transoral robotic surgery in head and neck cancer. *European Annals of Otorhinolaryngology Head and Neck Diseases*, 129(1), 32–37. <https://doi.org/10.1016/j.anorl.2011.06.003>