CASE REPORT

Successful management of a difficult airway in a case of advanced thyroid cancer

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Abstract

Papillary thyroid carcinoma is the most prevalent endocrine malignancy of the head and neck region. It makes up to 80% of all thyroid cancers, and has a 10-year survival rate of up to 95%. Differentiated thyroid carcinomas have good prognosis after a complete surgical extirpation as long as it is not associated with invasion of the surrounding structures. The advanced papillary thyroid carcinoma can invade the neighbouring structures of the thyroid gland, such as strap muscles, recurrent laryngeal nerve, trachea, oesophagus, larynx, pharynx, and carotids. Whenever papillary thyroid carcinoma is associated with invasion of aerodigestive tract it is difficult to excise the tumour. We report a patient with stage IV invasive papillary thyroid carcinomas as per Shin Staging system. The surgery was deferred from several hospitals considering the advanced stage of the disease with tracheal extension making it a problematic airway for both the anaesthesiologist and the operating surgeon. The patient underwent total thyroidectomy, modified radical neck dissection, tracheal resection, and primary anastomosis. Successful intubation was done with video laryngoscopy. Intermittent apnoea technique was used for ventilation during the repair of posterior tracheal wall. The patient was extubated on the table and shifted to the recovery room. The histopathologic diagnosis was reported as papillary thyroid carcinoma classic variant with tracheal invasion

Keywords: Thyroid cancer, tracheal invasion, tracheal resection, anaesthesia, airway management.

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Introduction

Among differentiated thyroid carcinomas, papillary thyroid carcinoma (PTC) is the most prevalent type. It makes up to 2.5% of all human cancers. Its occurrence is increasing day by day and according to literature it has increased up to 2.6 times during the last five decades.[1,2] It accounts for almost 80% of thyroid cancers and has a 10-year survival rate of up to 95%.[2] However, this survival rate can be reduced to 45% when we encounter patients with papillary thyroid carcinomas extending beyond thyroid tissue into the adjacent structures.[1,3] The prevalence of invasive papillary thyroid carcinoma with extra thyroidal extension is 6% to 13%.[1] Such aggressive tumours can invade any nearby structure of thyroid gland like strap muscles (53%), recurrent laryngeal nerve (47%), trachea (37%), oesophagus (21%), larynx, pharynx and major neck vessels.[1] The best method for radiological evaluation of the invasive thyroid carcinoma is computed tomography.[4] Furthermore, Shin and colleagues proposed the staging system of advanced papillary thyroid carcinoma based on the extent of invasion of trachea.[5] Surgical resection is the treatment of choice for all thyroid carcinoma. Advancements in surgical techniques have enabled surgeons to perform tracheal reconstruction with en bloc resections in aggressive thyroid carcinoma patients with simultaneous preservation of vocal cord function. On the contrary, aggressive papillary carcinoma extending into the trachea compromises the airway, which can be life-threatening and can pose challenges during airway management. In addition, emergence, extubation, and a good postoperative course is also needed to care for the newly reconstructed trachea after resection anastomosis. We discuss a case of aggressive papillary thyroid carcinoma invading the airway. Surgical and anaesthetic considerations are highlighted in detail.

Case Report

A 60-year-old female presented to the otolaryngology clinic at the Aga Khan University Hospital, Karachi on February 13, 2019, with left sided neck swelling, difficulty in breathing, and cough with sputum since the last one year. On physical examination, there was a 4x4cm solitary, firm, non-tender mass in the left lower side of the neck which was moving up on deglutition. Her thyroid profile was within normal limits. Cytology showed papillary thyroid carcinoma.

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A computed tomography (CT) as shown in Figure 1 revealed 4.3x4.1x3.8cm nodule which was completely replacing the left lobe of the thyroid gland; the mass was anteriorly abutting the adjacent strap muscles, laterally abutting the internal jugular vein, and infiltrating into the adjacent tracheal wall. This tracheal component was about 10mm in size. Right thyroid lobe appeared unremarkable. There were some bilateral enlarged cervical lymph nodes, the largest of which was at level II on the left side measuring 7mm. A clinical diagnosis of advanced papillary thyroid carcinoma (T4N1bMX, Stage IV) was made. The tumour was judged as resectable. However, it was feared that resection and reconstruction of trachea would be highly invasive.

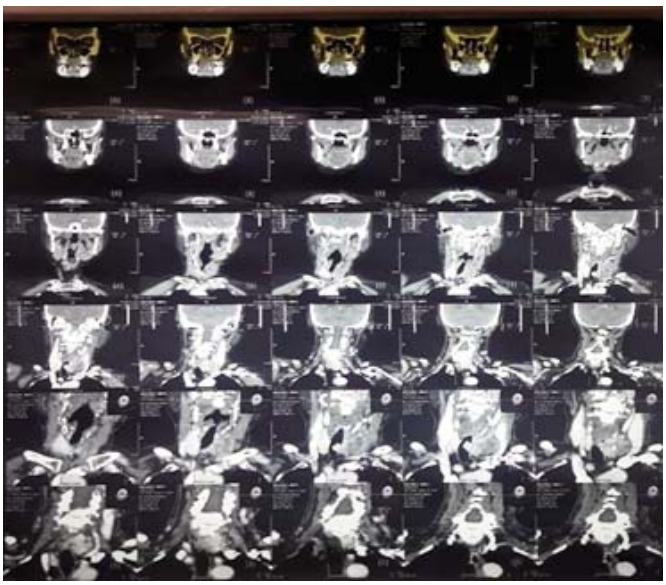

Figure-1: Coronal view of tomographic scan showing extension of papillary thyroid in the trachea.

In preoperative anaesthesia assessment, the patient was labelled as ASA III due to uncontrolled diabetes mellitus and functional class II. Her Mallampati grade was III, inter-incisor distance was three finger breadth, poor dental hygiene, and normal neck flexion-extension movement. The major concern was tracheal invasion by papillary carcinoma, causing shortness of breath and stridor. Surgery was deferred from multiple hospitals in the country due to distorted airway by the tumour that may have the potential for airway obstruction, failed intubation and haemodynamic collapse. She was initially planned for total thyroidectomy and bilateral II-IV and central neck dissection under general anaesthesia. She was admitted on February 18, 2019, at Aga Khan University Hospital, Karachi, and surgery was planned for February 19. Decision for tracheal resection and reconstruction was taken intraoperatively.

Difficult airway cart with fibre-optic bronchoscope (FOB), video-laryngoscope and all ancillary equipment for intubation were available in the operating room. The patient was monitored with electrocardiogram, Spo_2, end-tidal carbon dioxide ($ETCO_2$), non-invasive blood pressure, temperature, and urine output. An arterial line was placed in the left radial artery for beat-to-beat haemodynamic monitoring. An inhalational induction with Sevoflurane was started with increments of Propofol; once bag mask ventilation was observed to be adequate, Succinylcholine 1.5 mg/kg and Lignocaine 1.5mg/kg was given to facilitate intubation by video-laryngoscope. Size 7.0 reinforced endotracheal tube was passed and confirmed through bilateral chest rise, chest auscultation, and $ETCO_2$. Intraoperatively, tumour size of around 4x5cm involving the left lobe of the thyroid gland was seen, it was invading the left recurrent laryngeal nerve and underlying the second and third tracheal ring. Right lobe of the thyroid gland and recurrent laryngeal nerve appeared to be normal. The whole thyroid gland was removed from the trachea, involved tracheal segment was resected separately and end-to-end anastomosis was done with 3/O Prolene interrupted sutures and knot left outside the tracheal lumen. During the repair of the trachea posterior wall, brief periods of intermittent apnoea technique was employed. At this time, Dexmedetomidine at 6-8 microgram/kg/hour was infused for analog-sedation. The patient remained haemodynamically stable throughout the procedure. At the end of the surgery, a mentum stitch to the sternum was placed to keep the head and neck in flexion position to reduce tension on the suture line. Following recovery of consciousness and resumption of adequate spontaneous breathing, the patient was extubated on the table and shifted to the recovery room. Post-operatively, the patient was received in a vitally stable condition, in the special care unit. She was administered intravenous antibiotics and analgesics. Diet was started orally with clear liquids, which then progressed to regular. Upon remaining stable, the patent was shifted to the general care on post-operative day one. The endocrinology team was taken on board for the management of glucose, calcium, and thyroid. Calcium supplements were given and calcium was monitored periodically. Blood glucose was monitored and managed accordingly. Vitamin D was noted to be low and intramuscular supplement was administered. The endocrinology team also started Thyroxine 50mcg 2 tabs QAM, since the patient had to undergo radioactive iodine ablation after at least 2.5 to 3 months, and thyroxine had to be discontinued three weeks before ablation, and FT4 had to be measured 72

hours after starting thyroxine. The patient was counselled about the endocrinology plan. She wanted to continue further management in her hometown, Quetta. The patient was discharged on the third post-operative day on February 22, 2019.

Her final histopathology showed classic variant of papillary thyroid carcinoma. Tumour size of the left lobe was 4x3.4x2cm and the right lobe was 0.2x0.2cm, and isthmus measured 1x5cm. Macroscopically, grossly extending into muscle, surgical margins were <0.1cm away from the painted margins. Tumour showed multi-focality, and capsular invasion was present. Lymph vascular invasion was present. Tracheal segment was involved by the tumour (pt4n1b) as shown in Figure 2.

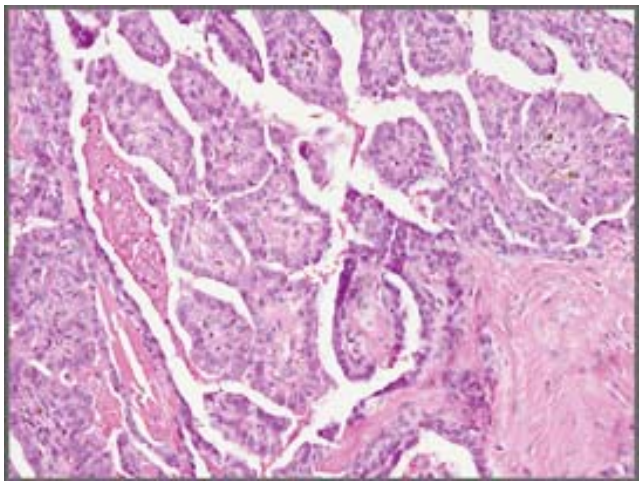

Figure-2: H&E stain (X10) showing papillary thyroid carcinoma infiltrating in between the skeletal muscle fibres

On her first follow-up visit after one week, she was doing well and her wound was fine and healing. Her consent was taken to use her surgical details for research purpose to which she agreed. She is on yearly follow-up since then and Tele follow-up was done in March 2022 where she was doing fine and was stable with no active issues.

Discussion

Well differentiated thyroid carcinoma usually presents as intrathyroidal tumour, however, sometimes patients with extra thyroidal extension are seen as well which makes up to 6-13% of the patients, which inversely affects survival of the patient.[1] Thomas et al[6] reviewed 262 cases of invasive papillary thyroid carcinoma and suggested that when these differentiated thyroid cancers extend outside the thyroid capsule and invade the nearby structures, the survival will be influenced by invasion. Judith et al[7] reviewed 292 cases retrospectively with invasive, well-differentiated papillary thyroid carcinoma, specifically laryngotracheal invasion, and compared different types of surgical resections and suggested it as independent prognostic factor for survival.

Invasion of windpipe by these aggressive cancers is the main cause of mortality in such patients. Treatment of choice in such patients is en bloc surgical resection of the tumour invading the airway. Neoadjuvant therapy with Levatinib can be offered to decrease the size of the tumour and neck nodes. The reported five-year survival rate of patients with aggressive thyroid malignancy extending into the upper aerodigestive system is 70%.[1] Ultrasound is the initial imaging modality for evaluation of thyroid nodule. Conversely, its reliability to detect invasive papillary thyroid carcinoma is questionable. A computed tomography is particularly an indispensable technique for the analysis of advanced papillary thyroid carcinoma4 because it can compare thyroid tissues with neighbouring structures with direct visual assessment. Additionally, it can illustrate cartilage involvement, whether cricoid or thyroid. It can provide excellent resolution of the neck and parabrachial lymph nodes.

Shin and colleagues proposed a staging system for advanced papillary thyroid carcinoma based on the depth of tracheal invasion as described in Table 1.[5] Taking this classification into consideration, our patient turned out to be stage IV category.

Table-1: Staging of advanced papillary thyroid carcinoma detailed by Shin and Colleagues

Stage I	Extension through the thyroid capsule and abutting the external perichondrium
Stage II	Invasion of the cartilage or destruction of the cartilage
Stage III	Extension into the lamina propria of the tracheal mucosa without epithelial invasion
Stage IV	Extension beyond the tracheal mucosa.

Table-2: Different surgical options for the management of advanced papillary thyroid carcinoma with tracheal invasion.

Shave excision	Excision of gross tumour with partial thickness resection of advanced papillary thyroid carcinoma. It is considered when there is no gross invasion of perichondrium
Tracheal window resection	Tumour resection and closure of small defects which are closed primarily by straps and sternocleidomastoid muscles depending on the location and size; anterior defects are converted into tracheostomy in some cases
Tracheal resection and end to end anastomosis	Indicated for majority of tumours involving anterior-lateral wall of trachea. Segmental resection and primary end to end anastomosis is performed
Laryngectomy	Indicated in aggressive disease involving the laryngeal lumen or cricothyroid cartilage or for invasive tumours with a non-functional larynx.

There is ample literature with description for the role of surgery and reconstructive techniques for the management of advanced papillary thyroid carcinoma with laryngotracheal invasion as summarised in Table 2.[1,8] These techniques guarantee breathing, digestive, and other symptomatic benefits to the patient. While operating on patients with advanced papillary thyroid carcinoma with airway invasion, the surgeon must consider certain factors to ensure maximum benefits to the patient for long-term survival. Those factors are: blood supply of trachea, length of involved tracheal segment, and preservation of recurrent laryngeal nerve. The surgeon can excise up to 5 – 6cm length of trachea with primary anastomosis and tracheal mobilisation. While performing such procedures the surgeon might create an unintentional pharyngectomy. Knowledge of techniques for closure resected segment of the trachea is also of paramount importance, otherwise the surgery would end up in catastrophic results. Closing of resected tracheal segment should be carried out with 3/0 and 4/0 monofilament non-absorbable suturing material. It should never be carried out in continuous manner but rather an interrupted manner; moreover, surgical knots must be tied outside the lumen of the trachea. Air tight sutures should be confirmed by deflating the endotracheal tube cuff, flooding surgical field with saline and asking the anaesthesiologist to perform a Valsalva manoeuvre.[1] The surgeon should avoid tracheostomy because it might be a source of contamination and granulation tissue formation. If bilateral vocal cords are paralysed or if glottis is involved by the tumour, tracheal reconstruction will offer very little benefit. Survival can be decreased with gross residual disease and recurrence of tumour. Differentiated thyroid carcinomas require an adjuvant treatment after an adequate surgery. Adjuvant postoperative therapies for advanced differentiated thyroid malignancies include Thyroxine, radioactive iodine ablation of the remnant, radioactive iodine therapy, external beam radiotherapy, and rarely chemotherapy. Radioactive iodine therapy should not be anticipated for compensation of inadequate resection of tumour. Radioactive iodine therapy destroys the residual malignant cells and residual thyroid tissues. It improves specificity of follow-up iodine scan and value of serum thyroglobulin.

The objectives of anaesthesia management of tracheal resection and reconstruction are continuous stability of the airway and an awake and cooperative patient at the end of the procedure. Active communication and vigilance about prompt needs as well as subsequent plans among the operating surgeon and anaesthesiologist are of paramount importance. The course of anaesthesia can be categorised into five phases; three of them are critical phases which are separated by two relatively non-critical phases. Initial phase is induction and intubation which is a critical period in which the airway is tight and potentially unstable. Second phase is the dissection phase, which is relatively less critical. The next phase is of opening the airway; this is a critical phase as in this phase anastomosis is being conducted and the airway is intubated across the field. This phase is followed by closure phase. The final phase is emergence and extubation, this is a critical phase as the newly reconstructed and at the same time potentially oedematous airway is extubated, assessed, and supported by intervention, as required.

It is well established that any sedation or induction of general anaesthesia in patients with laryngotracheal lesions may lead to complete obstruction of an airway. Anaesthesia for tracheal resection and reconstruction demands critical airway management. Furthermore, a set of special equipment must be present in the operating room. Videolaryngoscopy has been, unquestionably, one of the major advances in practical anaesthesia in recent times. The role of videolaryngoscopy in difficult intubations has recently been recognised in the Difficult Airway Society 2015 guidelines, which recommend that all anaesthetists have immediate access to a videolaryngoscope at all times.[9]

Conclusion

In conclusion, sharing an airway by the anaesthesiologist and the surgeon is a prerequisite for tracheal resection and reconstruction. To predict the course of operation and design a fruitful anaesthetic strategy, it is of paramount importance to understand the reason and characteristics of the tracheal pathology and how the position of the lesion affects the choice of the operative technique applied.

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References

1. Price DL, Wong RJ, Randolph GW. Invasive thyroid cancer: management of the trachea and oesophagus. Otolaryngol Clin North Am. 2008; 41:1155-68. doi: 10.1016/j.otc.2008.08.002.
2. Cramer JD, Fu P, Harth KC, Margevicius S, Wilhelm SM. Analysis of the rising incidence of thyroid cancer using the Surveillance, Epidemiology and End Results national cancer data registry. Surgery. 2010; 148:1147-53. doi: 10.1016/j.surg.2010.10.016.
3. Choi JS, Kim J, Kwak JY, Kim MJ, Chang HS, Kim EK. Preoperative staging of papillary thyroid carcinoma: comparison of ultrasound imaging and CT. Am J Roentgenol. 2009; 193:871-8. doi:

10.2214/AJR.09.2386.

4. Chandra M, Kundu R, Kochhar S. The value of clinical staging of thyroid cancer using ultrasonography and CT scan and its correlation with intraoperative and histopathological findings. Int Surg J. 2019; 6:2935-40. DOI: https://doi.org/10.18203/2349-2902.isj20193156
5. Shin DH, Mark EJ, Suen HC, Grillo HC. Pathologic staging of papillary carcinoma of the thyroid with airway invasion based on the anatomic manner of extension to the trachea: a clinicopathologic study based on 22 patients who underwent thyroidectomy and airway resection. Hum Pathol. 1993; 24:866-70. doi: 10.1016/0046-8177(93)90136-5.
6. McCaffrey TV, Bergstralh EJ, Hay ID. Locally invasive papillary thyroid carcinoma: 1940–1990. Head Neck. 1994; 16:165-72. doi: 10.1002/hed.2880160211.
7. Czaja JM, McCaffrey TV. The surgical management of laryngotracheal invasion by well-differentiated papillary thyroid carcinoma. Arch Otolaryngol Head Neck Surg. 1997; 123:484-90. doi: 10.1001/archotol.1997.01900050030003.
8. Friedman M, Danielzadeh JA, Caldarelli DD. Treatment of patients with carcinoma of the thyroid invading the airway. Arch Otolaryngol Head Neck Surg. 1994; 120:1377-81. doi: 10.1001/archotol.1994.01880360071013.
9. Frerk C, Mitchell VS, McNarry AF, Mendonca C, Bhagrath R, Patel A, et al. Difficult Airway Society 2015 guidelines for management of unanticipated difficult intubation in adults. BJA: Br J Anaesth. 2015; 115:827-48.