

Invasive Thyroid Cancer: A Novel Classification System to Standardize Reporting, Improve Stratification and Facilitate Outcomes Analysis

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Introduction

There is currently no locoregional classification system for thyroid cancer to characterize the degree of involvement of visceral, muscular, neurologic, vascular and osseous structures. The proposed system provides common language to facilitate risk stratification, enhance communication between clinicians, refine individualized patient care, and compare results of therapeutic intervention.

Methods

The components of the proposed classification system include the laryngotracheal complex, nerves, muscles, bones, vasculature, thoracic duct and pharyngoesophagus. These anatomic structures represent the major sites affected by disease extension from the primary tumor or regional lymph nodes located in the cervical or mediastinal nodal chains.

Results

Nerves: The degree of involvement is classified as being either epineural, which is amenable to nerve preservation, or more substantial invasion requiring complete section of the nerve. The specific nerves included are the recurrent laryngeal, superior laryngeal, vagus, spinal accessory, brachial plexus, and phrenic.

Muscle: The designated muscles include the anterior and deep musculature of the lateral compartment, infrahyoid strap and cricothyroid muscles.

Bone: The clavicular heads, manubrium and sternum are included.

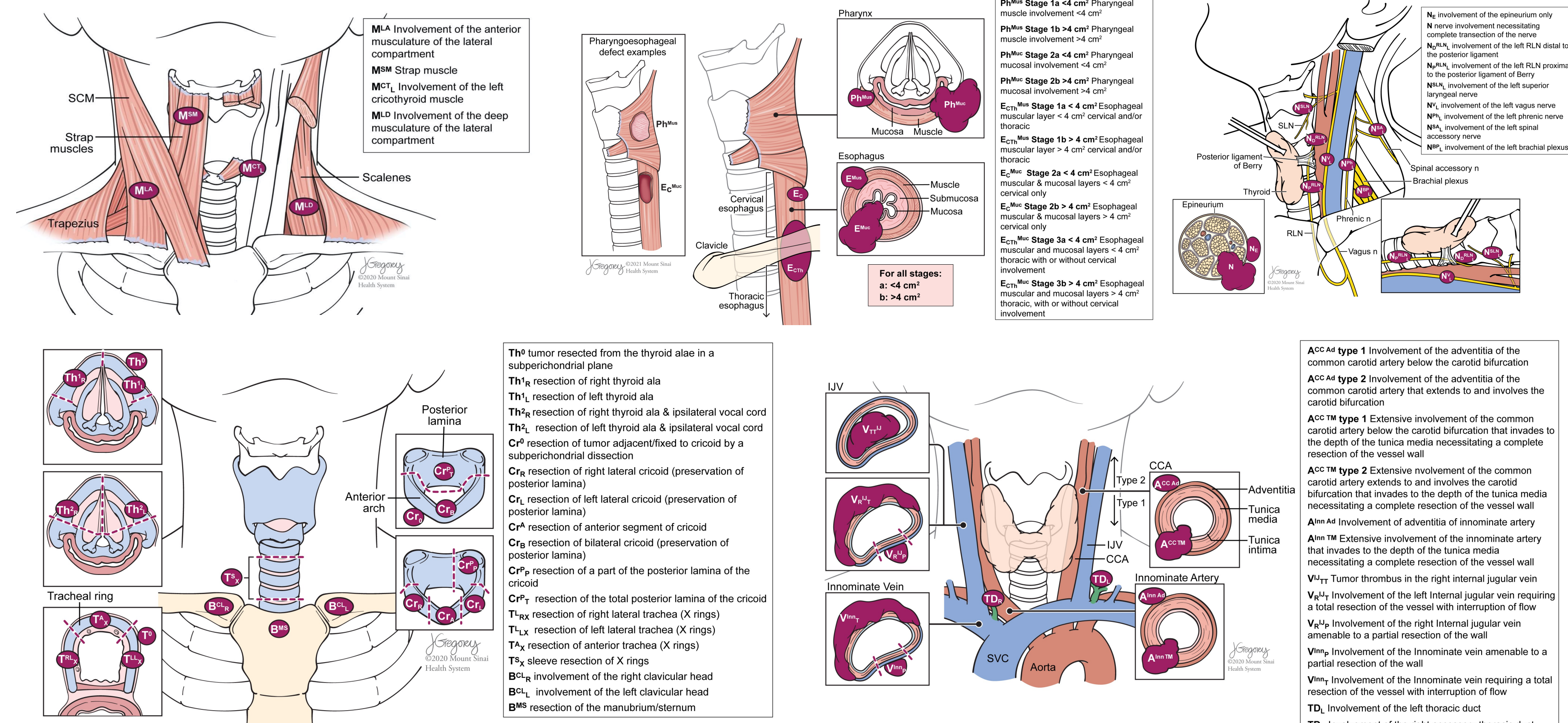
Arteries: The extent of arterial wall involvement is designated based on whether the tumor can be removed with vessel preservation by a subadventitial dissection or whether segmental vessel resection is needed.

Veins: The internal jugular and innominate veins are classified along with designations as to the need for partial resection or complete resection of a segment of the vein.

Thoracic Duct: Involvement of the thoracic duct is designated by laterality.

Laryngotracheal complex: The classification of laryngotracheal defects reflects the depth of invasion as well as the extent of the defect. Tracheal subclasses include perichondrial involvement and transmural invasive disease requiring full thickness resection and the number of rings involved.

Pharyngeal/Esophageal Defects: The size of the defect in the pharynx and esophagus are classified in addition to whether there is muscle involvement only or transmural defects involving muscle and mucosa.



Images & Data Analysis

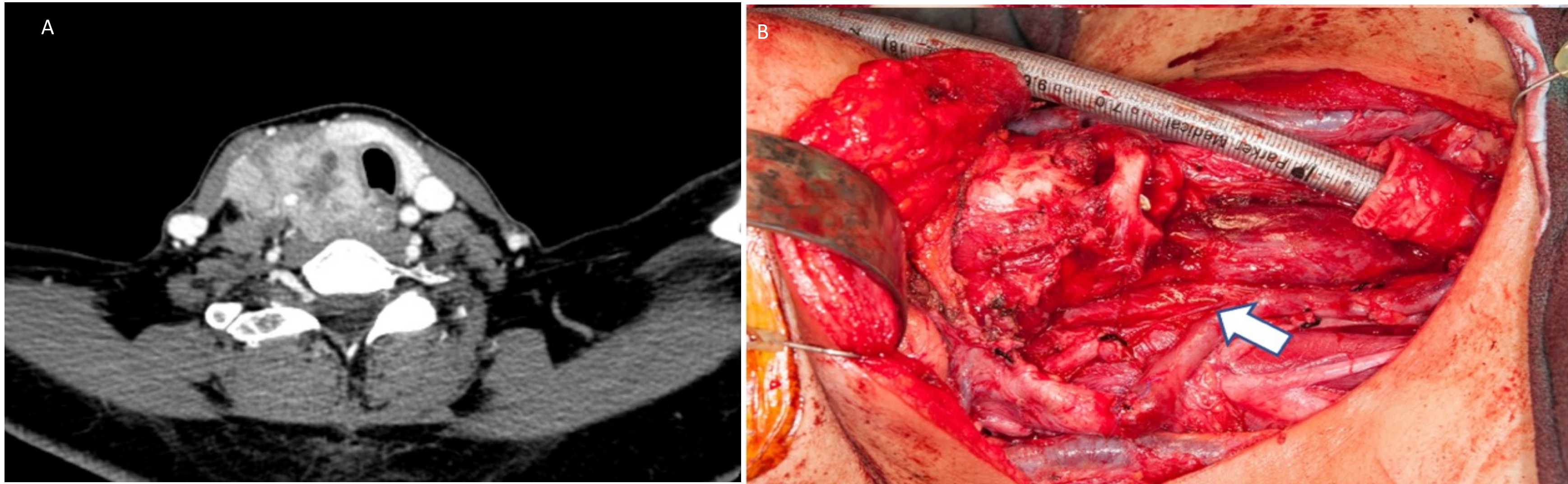


Figure 1(A). CT imaging demonstrates involvement of the trachea, carotid artery and the esophagus. (B). Resection of the cervical trachea (TS₅), muscular layer of the cervical esophagus (E_C^{Mus} Stage 2 > 4cm²) an entire segment of the right internal jugular vein (V_R^{IT}) and the right common carotid artery below the carotid bifurcation (A_{CC}TM_R type 1). (B). The common carotid artery was reconstructed with a vein graft (white arrow). End-to-end anastomosis of the trachea was performed. (C). The entire muscularis layer of the pharyngoesophagus was removed (blue arrow).

Discussion

A fundamental question related to invasive thyroid cancer, is whether the current AJCC and ATA ROR staging systems provide comprehensive information regarding disease stratification. The current AJCC¹ grouping of patients into T3b, T4a and T4b assumes that the prognosis of patients with gross extrathyroidal extension differs primarily based on the surrounding structures that are involved by this disease process. However, in the current reporting paradigm, there is not a mechanism that requires or promotes more detailed reporting of the various structures or the extent to which they are involved by cancer. For example, the current system does not differentiate between disease that can be removed from the larynx or trachea in a subperichondrial plane as opposed to disease that requires a more extensive structural resection in order to obtain clear margins.

Similarly, involvement of the esophagus that requires removal of the muscularis layer is currently not distinguished from disease that necessitates a transmural resection of both muscle and mucosal layers. Surgeons reporting the involvement of a structure such as the recurrent laryngeal nerve are not asked to differentiate between epineural involvement only and more extensive encasement of the nerve that requires complete transection. Finally, the current system makes no mention of internal jugular or innominate vein involvement. In addition, the interpretation of “carotid encasement” that leads to a T4b classification does not distinguish between the need for a subadventitial resection with carotid preservation versus a complete transection. The ability to define structural involvement in a detailed fashion is the first step in attempting to determine if it is appropriate to lump patients together in T3a, T4a and T4b classifications.

Discussion, cont.

The relative rarity of invasive thyroid cancer has been magnified by the increasing number of patients diagnosed with early-stage thyroid malignancies. In addition, the heterogeneity of thyroid pathologies makes the problem of evaluating oncologic outcomes of therapeutic intervention even more challenging. The information included in this proposed classification system is largely based on surgical findings and will not appear in a pathology report. It is our hope that surgeons will use this system in reporting the findings identified at the time of surgery. It is apparent that this approach relies upon the surgeon's perspective on the extent to which a tumor is invading a structure. We recognize the inherent limitations imposed by that. For example, a surgeon may perform a segmental resection of the trachea for disease that may in fact be amenable to a subperichondrial resection. Histologic analysis will be required to further elucidate this distinction.

Some of the information in this system holds the potential to further stratify patients to help to determine risk of death and risk of recurrence. Other information is designed to help to clarify the optimal methods for reconstruction and restoring function and quality of life. Granularity of information is imperative in order to discern the degree of involvement of a particular structure, rather than making that a binary determination. Unless a mechanism is in place to report detailed information such as this, then we will not be able to understand its significance. As Shin et al⁵ demonstrated, the degree of penetration of the trachea appears to impact oncologic outcomes. It is likely that the same may hold true for other structures.

Conclusion

Oncological classification systems are widely utilized to assist in achieving 4 primary goals:

- 1) deciding the best treatment for each patient
- 2) comparing results of therapeutic interventions;
- 3) improving prediction of patient outcomes; and
- 4) enhancing communication between physicians. The proposed classification system designates specific locoregional structures and the degree of their involvement by either primary or recurrent invasive thyroid cancers or nodal metastases. The goal of this system is to build upon the T and N classification and ultimately to improve and standardize treatments in this subset of patients. By so doing, it will aid in determining oncological outcomes with the goal of improving morbidity and mortality in the specific group of patients who have more aggressive thyroid malignancies.

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