In Re: Harnsberger HR, Osborn AG. Differential Diagnosis of Head and Neck Lesions Based on Their Space of Origin. 1. The Suprahyoid Part of the Neck. ***AJR Am J Roentgenol*** **1991;157:147–154 and Smoker WRK, Harnsberger HR.** Differential Diagnosis of Head and Neck Lesions Based on Their Space of Origin. 2. The Infrahyoid Portion of the Neck. ***AJR Am J Roentgenol*** **1991;157:155–159**

R. Thomas Bergeron

It is similar to poking around the dark and dusty corners of an inauspicious-looking bookstore and happening upon a prized first edition. Nestled between ''Case Reports'' and ''Opinions, Commentaries and Perspectives,'' in the ''Pictorial Essays'' section of the July 1991 issue of the *American Journal of Roentgenology* (*AJR*), were Harnsberger and Osborn's and Smoker and Harnsberger's contributions regarding differential diagnosis of head and neck lesions that have proved of exceptional, enduring value. Arguably the importance of these articles was diminished by editorial characterization of the ''Essay'': ''*unlike. . . articles [that are] based on original research, pictorial essays serve primarily as teaching tools, like exhibits at a scientific meeting. . .* ''). In this obscure spot, two short ''filler'' articles were presented to the readership of the *AJR.*

In such an unlikely and unheralded forum was published an exposition remarkable both for its erudition and clarity, as well as noteworthy for its watershed impact on the understanding and interpretation of cross-sectional imaging of the extracranial head and neck.

Harnsberger and Osborn (Part 1) and Smoker and Harnsberger (Part 2), during a period of brilliant productivity in the Neuroradiology Division at the University of Utah in the early 1990s, made no vaunted claims of ''original research'' in these two articles. What they did instead was reduce a largely unmanageable conglomeration of heretofore-published anatomic, pathologic, and radiologic data to a coherent set of algorithms facilitating the development of logical decision trees; this scheme yields weighted differential diagnoses for lesions throughout this tissue volume.

The premise is simple enough: establish the fascial space in which a lesion originates within the neck, and the differential diagnosis will be reducible to a very small number of choices. The latter redounds from the fact that the various fascial spaces in the neck have definably limited normal anatomic content from which pathologic processes may arise. Radiologic diagnosis subsequently becomes merely a function of ''rounding up the usual suspects'' that occupy the various individual spaces and, then, in the line-up, identifying the perpetrator.

The challenge of interpretation, then, reduces to: 1) identifying the spaces as they are defined by cervical fascial planes; 2) being familiar with anatomic occupants that normally dwell within each of those particular spaces; and 3) recognizing the radiologic morphology of normal anatomy gone awry.

At the time of publication of these two articles, this methodology had already come into use for the differential diagnosis of lesions in individual, particular spaces in this part of the body (eg, masticator and parotid space lesions, parapharyngeal space lesions, etc.). This methodology was the subject of antecedent publications by Curtin in 1987 and Som et al in 1988 (1, 2), and in a series of articles appearing in *Seminars in Ultrasound CT and MR* in 1990, edited by Raymond, Zweibel, and Harnsberger (3). Harnsberger also promulgated the concept in the first edition of his *Handbook for Head and Neck Radiology* (4). But these two short pictorial essays by Harnsberger and Osborn and Smoker and Harnsberger were the first to give a concise, comprehensive, and workable methodology—a kind of universal solution. These articles addressed the entire head and neck region, and presented it via a major international journal directed to a widespread radiologic readership, emphasizing the pivotal role of cervical fascial spaces. Therein lies the great utility of these pictorial essays.

The methodology works best with mass lesions—''a lump in the neck''—because localization largely depends on distortions and displacements secondary to vector forces. An expanding, discreet tumorous mass with its epicenter *posterior* to a certain space will displace those normal anatomic structures, and the surrounding *fat,* lying anterior to it, *anteriorly.* A discreet mass arising *laterally* will displace normal structures and fat medial to it, *medially,* etc. Phlegmonous, infiltrative processes, especially if they are diffuse and involve multiple compartments, or are accompanied by massive distortion, may prove more problematic insofar as identifying origin, but spread, either actual or potential, is greatly facilitated by understanding the anatomic integrity of the various fascial compartments.

Adipose tissue, the bane of contemporary Western culture, works to the diagnostician's advantage here. The various layers of cervical fascia that compartmentalize the neck are too thin to be readily perceived with cross-sectional imaging techniques.

But fat is normally interposed between the compartment and makes these layers identifiable as separate spaces of a certain contour defined by the invisible fascia. (Fat also lies *within* the various spaces, within some more than within others, permitting identification of at least certain structures therein).

The neck is divided in the vertical plane at the level of the hyoid (''*supra*- and *infra*hyoid neck'') not merely as a consequence of imposing an artfully tidy schematic conceit. Rather, this is a natural structural division wherein the three layers of the deep cervical fascia converge on the hyoid bone, effectively providing an inferior terminus for *some* of the spaces in the upper neck. Other compartments not confined by this convergence may traverse the entire suprahyoid neck, and then continue caudally within the infrahyoid neck to the level of the clavicles. In the case of the carotid space, there is continuation to the level of the aortic arch, and in the case of the ''danger space,'' to the level of the posterior diaphragm.

The parapharyngeal space, for example, is confined to the suprahyoid neck alone, and fat deformation, displacement, or obliteration by a lesion arising within this space may potentially affect one or more of four fascial spaces abutting its boundaries—the pharyngeal mucosal space, the masticator, carotid, and/or parotid spaces. Precise localization of the epicenter of the lesion arising in this region is possible as long as one remains attentive to vector theory. More posterior midline space lesions, retropharyngeal and prevertebral, traverse the entire span of the neck, and the epicenter of abnormality may be identified by direction of displacement of prevertebral muscles; retropharyngeal space lesions displace the muscles posteriorly, prevertebral space lesions displace the muscles anteriorly.

These two articles go on to identify all the cervical fascial spaces within both the supra- and infrahyoid neck and their appositional relationships with one another. Having done that, and having set forth the rules for displacements, all that is left is for the interpreter to learn what anatomic elements normally occupy each of the various spaces at the various levels. For example, the carotid space running the entire length of the neck contains the internal jugular vein, common or internal cartotid artery, and vagus nerve. The medial carotid sheath contains the sympathetic plexus. Lymph nodes are entwined within the entire circumference of the sheath as well. Thus, lesions to be encountered within the carotid space would pretty much be limited to the possibility of carotid body paragangliomas, neurogenic tumors, internal jugular vein phlebitis and thrombosis, vascular psuedotumors, and nodal disease. The radiologic morphology of each of these lesions, one as compared to another within this very limited set of possibilities, is relatively specific. And that's it. *Voilá*! In a word, to know *where* the lesion is, apropos to the cervical fascial spaces, provides an excellent method for predicting *what* the lesion is.

This methodology has stood the test of time for clinical application and continues, nearly a decade after its publication, to be the pedagogical touchstone for most formal instructional efforts directed toward disease assessment in the extracranial head and neck when using cross-sectional imaging techniques. Fascial space anatomy is complex, however, and not all anatomists agree with all of the boundaries as articulated by these authors (5), but this nonetheless remains an eminently workable concept.

Surgeons still rely on topographical landmarks, however, and providing information (even of this exceptional precision) as it relates to fascial spaces, rather than to visible, external landmarks, still occasionally evokes a murmur of dissatisfaction and discontent. Nevertheless, the very best among head and neck surgeons rejoice at the measure of anatomic understanding and the pathologic specificity proffered by their radiologic colleagues using this methodology; they put the information so derived to the greatest beneficial use in the care and management of their patients. This is the enduring value of these exceptional, and remarkably useful, pictorial essays.

References

1. Curtin HD. **Separation of the masticator space from the parapharyngeal space.** *Radiology*1987;;163::195–204
2. Som PM, Sacher M, Stollman AF, Biller HF, Lawson W. **Common tumors of the parapharyngeal space: refined imaging diagnosis.** *Radiology*1988;;169::81–85
3. Raymond HW, Sweibel WJ, Harnsberger HR, eds. **The suprahyoid neck: a spatial approach.** *Seminars in Ultrasound CT and MR.* 1990;11:
4. Harnsberger HR. ***Handbooks in Radiology. Head and Neck Radiology.*** St. Louis: Mosby-Year Book; 1990
5. Montgomery RL. ***Head and Neck Anatomy with Clinical Correlations.*** New York: McGraw-Hill; 1981