Lecture Two: Hydrodissection for Thermal Ablation for PTC — Anatomic Concerns and Techniques

This lecture provides a comprehensive, anatomically grounded account of hydrodissection as a critical safety technique in ultrasound-guided thermal ablation for papillary thyroid carcinoma, drawing on a comparative study of traditional versus improved fascial-space-based hydrodissection.

The lecture begins by establishing why hydrodissection matters. The thyroid lobe is intimately adjacent to a constellation of vulnerable structures — the trachea, esophagus, carotid sheath, and recurrent laryngeal nerve (RLN). Of these, the RLN deserves particular emphasis: it is the structure most commonly injured during thermal ablation, is invisible on conventional ultrasound in most cases, and is exquisitely sensitive to heat. Reported RLN injury rates across modalities range from 0.5% to over 5% for thermal ablation in some series. Creating a reliable hydrodissection barrier between the thyroid and these structures is therefore not optional — it is foundational to safe practice.

The lecture then addresses the anatomy underpinning improved hydrodissection. Three perithyroidal fascial spaces are identified as the anatomical targets. The anterior cervical space (ACS), situated between the infrahyoid muscles and the visceral fascia investing the thyroid, protects the strap muscles and carotid sheath when adequately hydrodissected. The visceral space (VS), lying between the thyroid and the trachea, is the critical space for protecting the trachea, esophagus, RLN, and superior laryngeal nerve. The post-thyroid space (POTS), posterior to the thyroid and carotid sheath and incorporating the retropharyngeal and danger spaces, provides protection to the carotid sheath, RLN, and stellate ganglion. Importantly, the VS cannot be fully dissected at the level of the suspensory ligament of the thyroid; continuous mild-pressure injection during ablation is required at this anatomical constraint to maintain a safe working distance.

The technical differentiation between traditional and improved hydrodissection is then examined in detail. Traditional hydrodissection involves placing the needle tip adjacent to the thyroid capsule and injecting normal saline until a nominal 5 mm separation is achieved. Ultrasound images demonstrate that the resulting fluid distribution is inconsistent, frequently causing soft tissue swelling rather than clean fascial plane expansion, and failing to achieve true anatomical separation. Improved hydrodissection, by contrast, targets the fascial spaces precisely. Correct needle placement is confirmed by the formation of an anechoic band with smooth borders following normal saline injection; soft tissue swelling indicates incorrect positioning and mandates needle repositioning under real-time ultrasound guidance.

The lecture proceeds to discuss the practical decision framework for selecting which fascial spaces to hydrodissect based on nodule location. Seven nodule location types are presented, each mapped to its corresponding required space or combination of spaces. For example, nodules above the suspensory ligament near the anterior capsule and trachea require ACS and VS dissection; nodules near the lateral thyroid capsule alone require ACS and POTS injection. This structured approach replaces empirical decision-making with a reproducible, location-driven protocol.