



JOHNS HOPKINS  
M E D I C I N E

# Superior Laryngeal Nerve Injury: Diagnosis and Management

Presented by: Nyall London

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# Case Presentation

- 49 year old male s/p right side approach anterior cervical discectomy and fusion (ACDF) in 2011
- Complained voice “low and gruff” after surgery which slowly improved for one month then plateaued
- He is a singer and reports losing the upper part of his singing register
- Patient saw Dr Best 7/7/2014 where videostroboscopy demonstrated normal TVC movement but subtle right abduction deficit

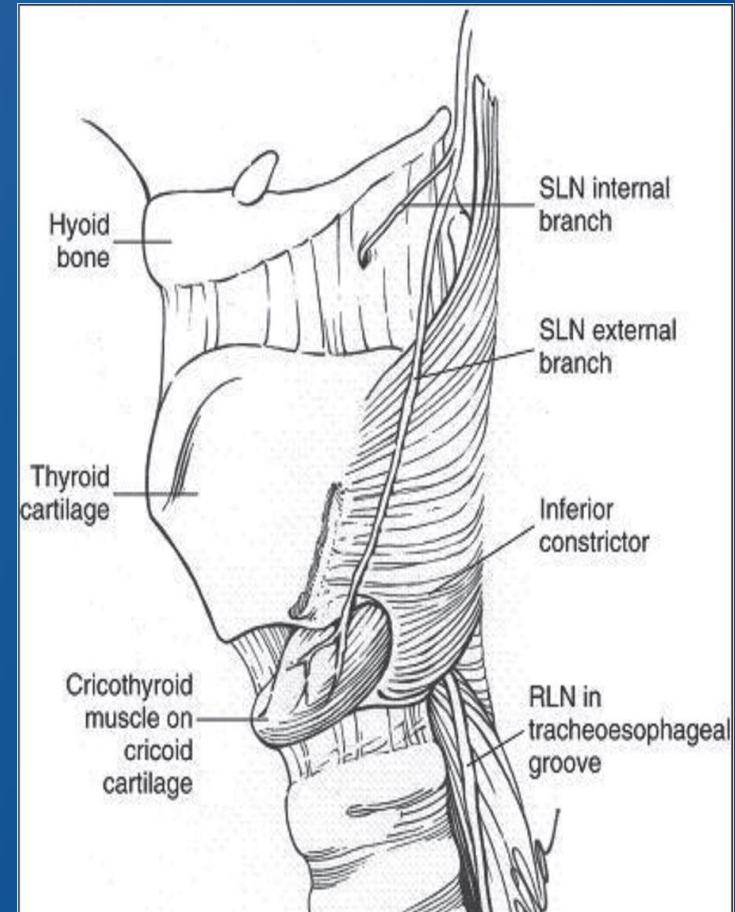
# Case Presentation



- Differential diagnosis includes recurrent laryngeal nerve injury (RLN), superior laryngeal nerve (SLN) paresis, and muscle tension dysphonia
- Patient has had multiple visits with Kristine Teets for voice therapy

# Superior Laryngeal Nerve Anatomy

- SLN branches from the vagus and innervates the cricothyroid muscle
- The external branch controls longitudinal tension of the vocal folds and voice pitch
- Symmetric contraction of the cricothyroid muscle raises the anterior cricoid cartilage resulting in narrowing of the cricothyroid space, posterior and inferior motion of the arytenoids, and lengthening and thinning of the vocal folds



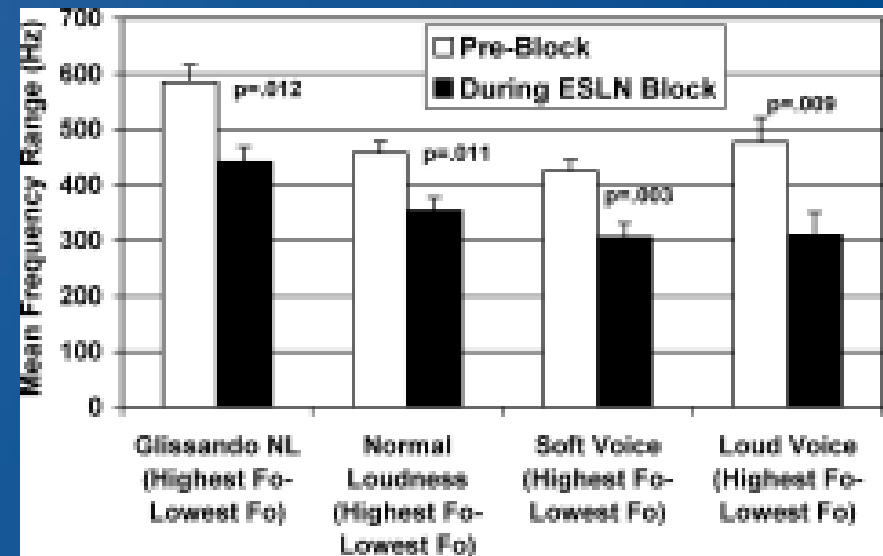
# Clinical Practice Guidelines – Protection of the SLN During Thyroidectomy



- “At the very least, the surgeon should ensure that the EBSLN is not injured at the time of dividing tissue at the superior pole by identification of its course or excluding its presence in the divided tissue visually or by nerve monitoring”
- “Operative vigilance and careful dissection of the superior pole vessels should result in decreased EBSLN damage with good voice outcomes. However, in those cases where anatomy is altered by cancer or thyromegaly, overaggressive search in altered planes of dissection could jeopardize the EBSLN by stretching or severing it”

# Phonatory Effects of SLN paralysis

- Roy *et al.* performed selective blockage of the cricothyroid muscle and external branch of the superior laryngeal nerve with lidocaine in 10 vocally-normal adult males
- The most common effect on the voice was a reduction in the highest and lowest obtainable frequency



# Diagnosis – Findings on Laryngoscopy



- It is difficult to establish diagnosis on laryngoscopy alone due to subtle findings and high variability
- Vibratory phase asymmetry has been thought to be the most common finding on laryngoscopy but is not specific to SLN paralysis

# Diagnosis – Findings on Laryngoscopy

- A study comparing RLN vs SLN/RLN injury found no statistical differences in glottal configuration such as glottal shape, paralyzed vocal cord shape, normalized glottal gap area, and glottal shape

**Table 2.** Comparison of Glottal Configuration between the RLN Injury Group and the Concurrent SLN/RLN Injury Group.

Parameter	RLN Injury (n = 26)	SLN/RLN Injury (n = 8)	Test	P
Glottal angle, median ° (IQR °)	32 (26-38)	40.5 (29-45.5)	M-W U test	.215
Paralyzed vocal fold shape				
Straight, n (%)	14 (54)	2 (25)	Fisher exact test	.232
Bowed, n (%)	12 (46)	6 (75)		
Normalized glottal gap area, median (IQR)	6 (2.8-9.3)	11.8 (7.7-14.4)	M-W U test	.067
Glottal shape				
Triangular, n (%)	12 (46)	3 (37)	Fisher exact test	>.990
Fusiform, n (%)	14 (54)	5 (63)		

Abbreviations: IQR, interquartile range; M-W U test: Mann-Whitney U test; RLN, recurrent laryngeal nerve; SLN, superior laryngeal nerve.



# Diagnosis

- Laryngeal electromyography (LEMG) has been the gold standard in diagnosis due to ability to detect signs of denervation
- Limitations of LEMG include interpretation of LEMG findings is subjective and accuracy is dependent on experience, and can be technically difficult to perform

# Treatment

- Voice therapy is the most commonly prescribed therapy for long-standing isolated SLN paralysis, although the improvement in voice is variable
- Therapy is targeted at building cricothyroid muscle strength using activities such as glissando maneuvers

# Treatment - Surgical

- Shaw *et al.* used unilateral cricothyroid approximation to increase cricothyroid adduction (type 4 thyroplasty) in a series of 10 patients
- Postoperative acoustic and perceptual analysis was performed up to 18 months later
- Statistically significant improvement was achieved in both quality of voice and vocal range although some deterioration was noted between early and late results

# Treatment - Surgical

- Nasserri and Maragos performed both type 1 and type 4 thyroplasty in 9 patients.
- The addition of medialization likely enhances the compensatory activity of the thyroarytenoid muscle, increases stiffness of the vocal cord, and allows for more efficient increases in subglottic pressures leading to improvement of quality of voice and range.
- Significant improvement in subjective symptoms including breathiness, poor pitch control, and vocal fatigue.
- There was also improvement in mucosal wave symmetry and amplitude.

# Treatment - Surgical

- Selective cricothyroid reinnervation was attempted in 3 patients using the muscle-nerve-muscle neurotization technique
- A segment of peripheral nerve long enough to span between the cricothyroid muscles was harvested from the ansa hypoglossi
- One end of the graft was buried in the belly of the innervated cricothyroid muscle and the other end was buried in the denervated side
- The graft was secured at the point of entry into each muscle using fine suture from epineurium to muscular fascia

# Post-Reinnervation LEMG Demonstrates Activity

Spontaneous

A



Vocal tasks demonstrating recruitment

B



# Conclusions

- SLN injury is uncommon and difficult to diagnose with high variability
- LEMG is the gold standard for diagnosis and voice therapy is the current standard of treatment
- Surgical options exist including thyroplasty and nerve cable graft although these are uncommon