Accuracy of NIM Vital in Definitive Breakpoint Identification in Hypoglossal Nerve Stimulation Surgery: A Blinded Reviewer Analysis

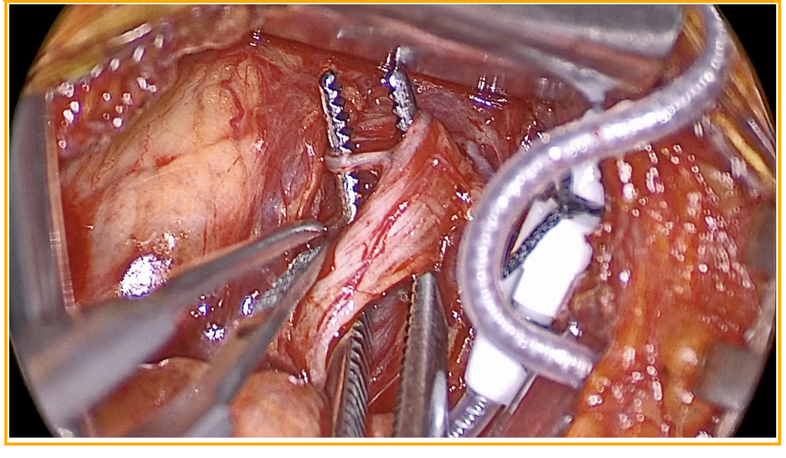
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Introduction

- Hypoglossal nerve stimulation (HNS) is an established treatment for OSA[1].
- Optimal efficacy of HNS treatment requires accurate placement of stimulation cuff on the hypoglossal nerve to include nerve branches responsible for tongue protrusion and stiffening, while excluding branches responsible for tongue retraction[2].
- Nerve branching patterns are variable[3], and retractor branches may be small and easily overlooked (**Figure 1**).
- This study aims to evaluate the accuracy of nerve integrity monitoring (NIM) across multiple anatomical locations and nerve signals

Figure 1 Small Retractor Branch



Methods

- NIM waveforms at various branchpoints were recorded for 28 patients during hypoglossal nerve stimulator implantation.
- NIM waveforms were reviewed by blinded expert reviewers (otolaryngologists and device representatives)
- NIM waveform signals with less than 2/3 agreement were excluded
- Sensitivity and specificity were calculated based on the surgeon's identification of nerve branch points.

Results

- Overall accuracy of NIM was 0.93
- Overall specificity of NIM (macro averaged) was 0.97
- NIM is least accurate proximal to branch breakpoints with limited potential to rule out more distal retractor branches.
- Sensitivity and specificity were lowest for mixed signals, and highest for exclusion signals.
- Intra-rater and inter-rater reliability both measured "near perfect" agreement levels (Cohen's kappa = 0.91, Fleiss' kappa = 0.82 respectively)

Table 1 Diagnostic Accuracy by Location

	Proximal branch		Middle branch		Distal branch	
	Sensitivity	Specificity	Sensitivity	Specificity	Sensitivity	Specificity
Inclusion	NA	0.78 (0.61–0.89)	0.95 (0.89–0.98)	0.97 (0.94–0.98)	0.89 (0.83–0.94)	0.99 (0.96–1.00)
Mixed	0.75 (0.57–0.87)	NA	0.92 (0.73–0.98)	0.96 (0.94–0.98)	NA	0.94 (0.90–0.96)
Exclusion	NA	0.98 (0.87–1.00)	0.93 (0.90–0.95)	0.99 (0.96–1.00)	0.98 (0.94–0.99)	1.00

Table 2 Overall Comparison

Group	Subgroup	Metric	Subjects (n)	Recordings (n)	Estimate (95% CI)
Total	All	Accuracy	24	1069	0.93 (0.91–0.95)
	All	Specificity	24	1069	0.97 (macro average)
By Location	Proximal	Accuracy	3	50	0.75 (0.57–0.87)
	Middle	Accuracy	24	600	0.94 (0.91–0.96)
	Distal	Accuracy	13	419	0.94 (0.90–0.96)
By Signal	Inclusion	Sensitivity	19	359	0.92 (0.87–0.95)
		Specificity	22	710	0.96 (0.94–0.98)
	Mixed	Sensitivity	4	90	0.83 (0.70–0.91)
		Specificity	24	979	0.95 (0.93–0.97)
	Exclusion	Sensitivity	21	620	0.95 (0.92–0.96)
		Specificity	19	449	1.00 (0.98–>0.99)

Conclusion

- NIM data alone cannot reliably exclude the presence of a hidden retractor branch during HNS nerve dissection.
- Accuracy of NIM is variable depending on location and signal.
- NIM is highly specific for identification of distal exclusion branches.
- Further dissection along branches identified as exclusion branches by NIM for confirmation may be unnecessary.

References

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