Dr. Catherine F. Sinclair: my thoughts on continuous intraoperative neuromonitoring using the laryngeal adductor reflex

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Editor's note

The focused issue "*The Management of Thyroid Tumors in 2020 and Beyond*" edited by Drs. Jonathon Russell and Jeremy Richmon is going to be released in *Annals of Thyroid* (*AOT*) in the coming months. This issue aims to review the state-of-art in the management of thyroid pathology, to provide a venue for original research focused on remote access or minimally invasive thyroid management and to review the success at extending proven management strategies into new geographic regions. Taking this opportunity, we have done a series of interviews with the authors discussing the highlights of their articles and sharing their experiences or stories in this field.

Dr. Catherine F. Sinclair is an associate professor at Mount Sinai West in New York, where she serves as the director of Head and Neck Surgery. Dr. Sinclair's particular area of expertise is surgical management of neck endocrine diseases including thyroid nodules, thyroid cancer, and parathyroid gland disorders, with an emphasis on voice preservation and outcomes. It is considerable honor for *AOT* to interview Dr. Sinclair on her current research, opinions on continuous intraoperative neuromonitoring (CIONM) using the laryngeal adductor reflex (LAR) (termed LAR-CIONM).

Expert's introduction

Dr. Catherine F. Sinclair (*Figure 1*) is an associate professor at Mount Sinai West in New York, where she serves as the director of Head and Neck Surgery. She completed dual fellowships in head and neck surgery and laryngology at the University of Alabama at Birmingham and the New York Center for Voice and Swallowing, respectively. She holds positions on numerous committees nationwide including the Endocrine Section of the American Head and Neck Society, the Surgical Committee of the American College of Endocrinologists, the Guidelines committee of the American Thyroid Association, the Neuromonitoring Taskforce of the American Head and Neck Society, and the Women in Surgery Committee of the American Head and Neck Society. Research interests include intraoperative neuromonitoring of laryngeal nerves during thyroid and parathyroid surgery and neurophysiology of the human larynx. She has published and spoken widely on these and other related areas.

Figure 1 Catherine F. Sinclair, MD.

Dr. Sinclair's particular area of expertise is surgical management of neck endocrine diseases including thyroid nodules, thyroid cancer, and parathyroid gland disorders, with an emphasis on voice preservation and outcomes.

Interview

AOT: How did you become involved in your research field and what is the focus of your recent research?

Dr. Sinclair: I completed a Head and Neck surgical oncology fellowship at the University of Alabama at Birmingham followed by a Neurolaryngology fellowship at the Center for Voice and Swallowing Disorders in New York. The combination of these fellowships fed my interest in neck endocrine surgery, where laryngeal nerve injuries

are one of the most feared and morbid intraoperative complications. During my two fellowship years, my mentors (Dr. William Carroll and Dr. Andrew Blitzer) encouraged me to get involved in clinical research. And I published many articles and book chapters and thoroughly enjoyed the experience.

After I started work as an attending surgeon, I approached neurophysiology colleagues (Dr. Sedat Ulkatan and Dr. Maria Tellez) to begin a research project involving monitoring sensory function of vagal and recurrent laryngeal nerves. We subsequently discovered a laryngeal reflex thought to be absent in humans under general anesthesia, called the LAR. Over the past 3 years, we have used the LAR to develop a completely new and unique method to continuously monitor the vagus and recurrent laryngeal nerves intraoperatively. Clinical interest in this new technique, particularly amongst the neurophysiology community, is significant. Most recently, we have applied the technique to map and monitor sensory vagal fibers during high vagal schwannoma resection, the first time ever that peripheral sensory vagal fibers have been able to be electrically identified and continuously monitored during neck surgeries.

In addition to the neuromonitoring applications of the reflex, we have discovered that the same early reflex component is present in awake humans and have mapped the human larynx for low stimulus sensory receptor density for the first time. We are currently working on defining the contribution of the different reflex components to vocal fold adduction and on different techniques for reflex elicitation and recording.

AOT: LAR-CIONM is a new way to perform CIONM. Would you like to introduce us to LAR-CIONM?

Dr. Sinclair: Thank you. Yes, the LAR is a very promising new technique for continuous vagal and recurrent laryngeal monitoring although there is much confusion, even amongst surgical experts in nerve monitoring, about exactly what LAR-CIONM entails and how it differs from existing CIONM vagal electrode techniques. The single most important factor to understand about LAR-CIONM is that it is completely different from any other vagal neuromonitoring technique currently available. All other techniques work by eliciting a compound muscle action potential (CMAP) in the laryngeal muscles to cause vocal fold contraction. This CMAP response is elicited by direct motor nerve stimulation, either through direct recurrent laryngeal or vagus nerve stimulation using a handheld probe (in the case of intermittent nerve monitoring) or through continuous vagal nerve stimulation using an electrode placed around the vagus nerve (in the case of continuous monitoring). Many papers have been published on such CMAP monitoring techniques, particularly by the International Neural Monitoring Study Group, and the recommendations from these papers are widely cited.

By contrast, CIONM using the LAR (termed LAR-CIONM) is different. Firstly, it is a reflex response that has afferent, central and efferent components. This allows for monitoring of sensory, central and motor vagal function. Secondly, although the end result of reflex elicitation is vocal fold contraction, this response is not a CMAP response. Instead this is a bilateral reflex response with distinct latency (16–22 ms for the early R1 response and 50–60 ms for the later R2 response) and amplitude characteristics that do not conform to the preexisting standards of CMAP IONM. The bilateral nature of the response allows for the contralateral vocal fold to serve as a 'control' against endotracheal tube rotation or displacement. Thirdly, and perhaps most importantly, warning criteria for nerve injury when using LAR-CIONM are distinct from those published for CMAP-CIONM. Applying the same standards to LAR-CIONM as have been publicized for CMAP-CIONM is thus not feasible and should not be attempted due to their completely different underlying neurophysiologic principles.

Unlike CMAP-CIONM which requires that an electrode be placed around the vagus nerve in addition to a monitored endotracheal tube, LAR-CIONM requires no equipment other than a monitored endotracheal tube and baseline readings can be taken prior to skin incision. It is exquisitely sensitive to nerve irritation and loss of LAR signal accurately predicts postoperative vocal fold motion impairment. However, as for any method of CIONM, the usefulness of the technique is only as good as the surgeon using it and the surgeon must be prepared to act on any amplitude declines noted intraoperatively by releasing tissue, taking a break from dissection, irrigating, etc. In an upcoming publication looking at our nerve injury rates with intermittent IONM versus LAR-CIONM, we show that

LAR-CIONM has significantly reduced the transient nerve injury rates in primary thyroid surgeries.

AOT: What is the current status and future outlook of it?

Dr. Sinclair: We have now monitored over 400 nerves at risk with LAR-CIONM. The technique is highly sensitive to nerve irritation. Given its non-invasive nature, it has particular applicability to remote access and minimally invasive approaches to the thyroid and parathyroid glands. In addition, it has been used for brainstem monitoring of vagal function during posterior fossa surgeries. We are currently working on optimizing LAR responses and on making the technique available in a single surgeon format, utilizing data gathered from our own experience. In the near future we hope to see the same enthusiasm about this technique amongst surgical colleagues as is currently present amongst our neurophysiology colleagues.

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Footnote

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(Science Editors: Silvia Zhou, Wymen Chen, AOT, AOT@amegroups.com)

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