

Letter to the Editor

The intraoperative laryngeal adductor reflex (LAR) in brainstem tumor removal: A case of unilateral loss of LAR signal



The laryngeal adductor reflex (LAR) is a new method for intraoperative monitoring (IOM) in thyroid and cervical spine surgeries, where the integrity of the peripheral branches of the vagus nerve is threatened (Sinclair et al., 2017, 2018). Moreover, LAR could be useful in the IOM of brainstem surgeries, because the reflex arc passes through the lower brainstem and involves the vagal nuclei. In combination with other IOM methods, LAR can aid localizing the imminent damage (right or left, afferent or efferent, supranuclear) (Costa et al., 2018).

LAR is a vago-vagal protective reflex induced by stimuli at the larynx. Figure 1 presents the schematic model of the reflex arc. The supralaryngeal nerves mediate the impulse to the ipsilateral nucleus of the tractus solitarius. In the brainstem, through interneurons, the impulse reaches the bilateral ambiguous nuclei. From the n. ambiguus, the efferent vagal neurons (n. recurrens, RLN) mediate the reflex bilaterally to the larynx, resulting in thyroarytenoid muscle contraction and vocal fold closure (Sasaki et al., 2003). As a part of IOM, LAR can be induced by an electrical stimulus to the laryngeal mucosa and recorded in the vocal folds. During brainstem operations, a pair of hook-and-wire electrodes in each m. thyroarytenoideus is recommended for recording (Costa et al., 2018). LAR can be recorded ipsi- and contralaterally to the side of the stimulation. The response comprises two components: the short latency R1 and long latency R2. In practice, the more stable and larger R1 is monitored (Sinclair et al., 2017).

In thyroid surgery, the peripheral branches of vagus nerves are at risk. According to Sinclair et al. (2018), LAR is highly sensitive to stretch or compression of RLN. In that study, >60% decrement in the amplitude of LAR, or an absolute closing amplitude < 100 μ V indicated postoperative vocal cord paralysis. However, in brainstem surgery, the predictive significance of intraoperative LAR change is not established. In the three brainstem cases reported by Costa et al. (2018), the preservation of LAR at the end of the procedure correlated with the absence of new neurological deficits related to dysphonia, dysphagia or breathing. Here we report a case, in which LAR was unilaterally lost during lower brainstem surgery.

We applied the LAR monitoring in a removal of a large IV ventricle astrocytoma in a 12 year-old girl. In addition to LAR, the IOM protocol included free-run EMG, brainstem mapping (BSM), limb muscle motor evoked potential (MEP) monitoring to transcranial stimulation, and tibial nerve SSEP. Corticobulbar MEP monitoring was not successful. Recording (a pair of needles or hook-and-wire electrodes) was set up bilaterally in m. masseter, orbicularis oculi,

orbicularis oris, soft palate, trapezius, and tongue, in addition to a few muscles in each limb. In addition, an ear, nose and throat specialist placed two hook-and-wire electrodes in each m. cricoarytenoideus. BSM was performed with a hand held monopolar stimulator (single, monophasic, 0.2 ms pulses; intensity \leq 1 mA). LAR was recorded at about 0.5–5 min intervals throughout the procedure. The right and left side of the laryngeal mucosa were stimulated separately via the surface electrodes embedded in the endotracheal tube (train of three 0.2 ms pulses, inter-stimulus interval 3 ms, intensity \leq 20 mA). LAR responses were recorded by the wire electrodes in the thyroarytenoideus muscles, contralaterally to the stimulation.

Before beginning the tumor removal, BSM was performed. BSM localized the right side nucleus ambiguus close to the supposed edge of the tumor. The hypoglossal and accessory nuclei were slightly further away. From the beginning of the operation LAR R1 components were well discernible and reproducible bilaterally. The R2 component was visible, too, but it fluctuated in latency and amplitude. On the left, the amplitude and latency of R1 were 120 μ V and 24 ms. On the right, they were 600 μ V and 25 ms, respectively. The stimulation intensity was 13 mA on both sides. About half way through the removal of the tumor, the right m. cricoarytenoideus presented an intense and persistent neurotonic discharge. Seven minutes later it was joined by a discharge in the right m. trapezius. Next, an episode of bradycardia and blood pressure alterations occurred, which was taken for a vagal reaction to manipulation. About 30 min after the emergence of the neurotonic discharge in the right m. cricoarytenoideus, the right side LAR diminished rapidly in amplitude, and the latency of R1 increased to 28 ms. In two minutes time the right LAR vanished. The left LAR remained unaltered. Figure 2 presents the evolution of LAR during the operation.

The impedance in all electrodes, including the endotracheal tube electrodes used for stimulation, was checked. The stimulation intensity was increased to 20 mA. An ipsilateral stimulation was tested; the ipsilateral LAR was recorded on the left, but not on the right. However, during the end of the procedure, the repeated BSM elicited the left and right cricoarytenoideus responses. LAR on the right side never recovered.

Postoperatively, the patient presented no deficits in laryngeal, swallowing or other functions.

The disappearance of the right side LAR to left and right side stimulation, while left side LAR to right and left side stimulation was preserved, indicates an intact afferent pathway. However, the right m. cricoarytenoideus response was present in BSM at the closing, which correlates to gross preservation of the efferent pathway. This could suggest that the disturbance of the reflex arc was located at the inter neuron pool in the brainstem.

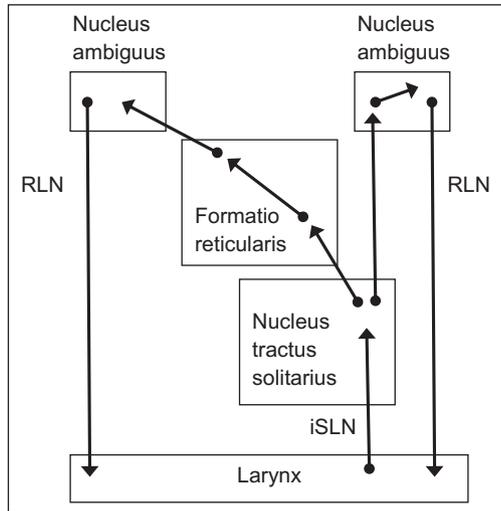


Fig. 1. The organizational model of laryngeal adductor reflex arc. The ipsi- and contralateral R1 response pathways are shown. The figure is modified from [Sasaki et al., 2003](#); with permission from C. Sasaki. (RLN = recurrent laryngeal nerve; iSLN = internal branch of superior laryngeal nerve).

In our patient, the unilateral loss of LAR did not indicate postoperative laryngeal deficit. In conclusion, more experience in the significance of intraoperative LAR changes in brainstem surgery is needed.

Declaration of Competing Interest

None of the authors have potential conflicts of interest to be disclosed. There are no sources of funding to be declared.

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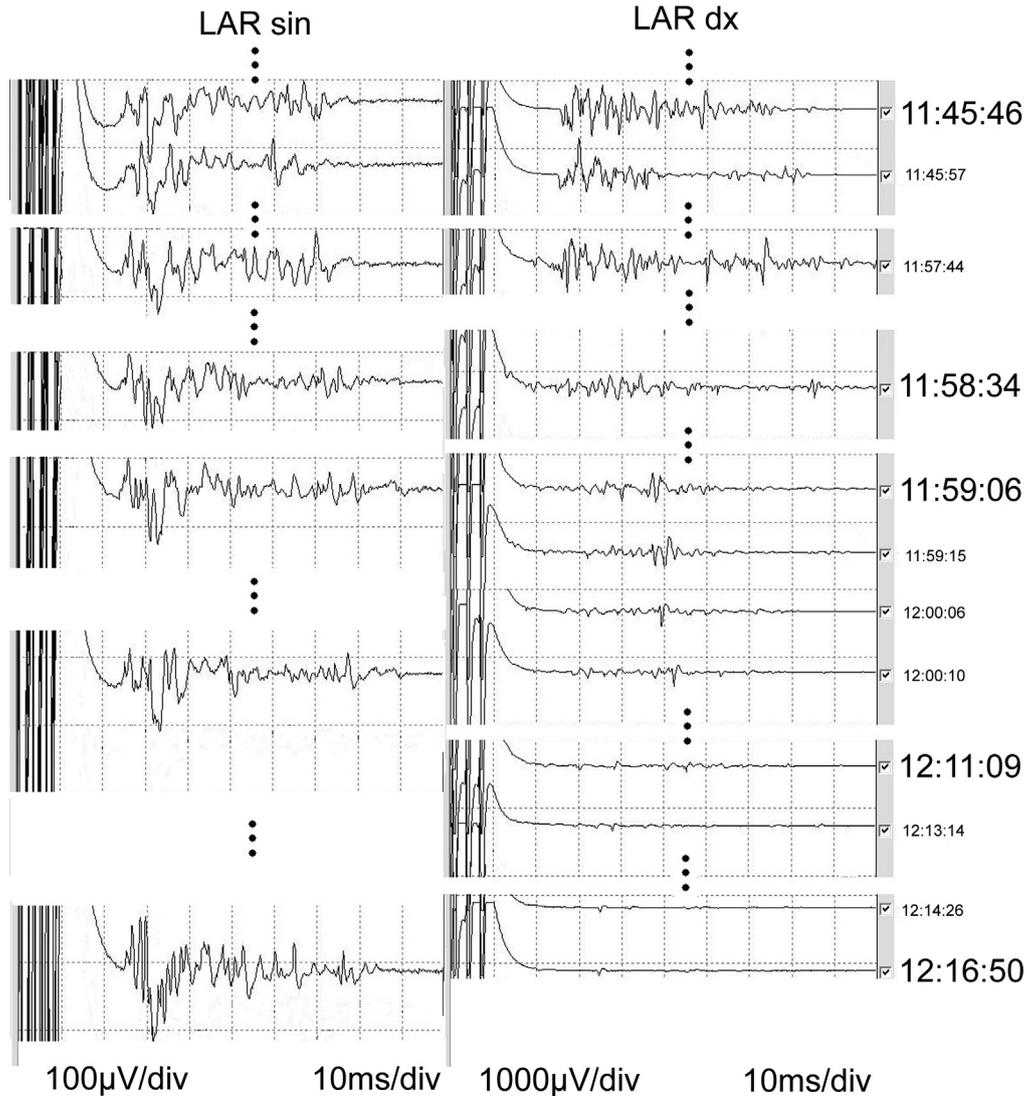


Fig. 2. The intraoperative LAR. On the left and right panel, the LAR responses recorded in the left and right m. cricoarytenoideus, respectively. The right side LAR decreased in amplitude at 11.58.34, and vanished at 12.11.09. The left side response remained at baseline level. Selected traces around the decrement episode are shown. (On the left, 100 µV and 10 ms/div. On the right, 1000 µV and 10 ms/div.)

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Accepted 6 May 2019

Available online 13 May 2019