CASE REPORT

Access this article online
Quick Response Code:

Website:
www.jcritintensivecare.org
DOI:
10.14744/dcybd.2024.40042

# Safeguard the Airways: Detecting Post-Extubation Vocal Fold Motion Impairment Using Laryngeal Ultrasound: A Case Study

Sara Eltayeb, Eleia Mosaad

**Abstract**

Vocal fold motion impairment is a rare but serious complication of endotracheal intubation, traditionally diagnosed with flexible fiberoptic endoscopy. Point-of-care ultrasound is emerging as a valuable tool for airway assessment and guiding interventions. We present a case of a 21-year-old female patient with infective endocarditis who was intubated for cardiac surgery. After extubation, she developed hoarseness of voice and aspiration. A laryngeal ultrasound using a high-frequency linear probe revealed left vocal fold paresis, consistent with her clinical findings. A nasogastric tube was placed to prevent aspiration and ensure adequate nutrition. Ten days later, follow-up ultrasound demonstrated improved vocal fold movement, allowing for the removal of the nasogastric tube. Laryngeal ultrasound is a safe, reliable, and repeatable method for the early detection and monitoring of vocal fold motion impairment following extubation, reducing the risk of aspiration and enhancing patient outcomes.

**Keywords:** Point-of-care ultrasound (POCUS); Laryngeal ultrasound; Vocal fold motion impairment; Vocal fold immobility.

## Introduction

Endotracheal intubation, a common procedure in anesthesia and critical care settings, can lead to a rare but serious complication known as vocal fold motion impairment (VFMI).[1] Vocal fold motion impairment is a condition characterized by reduced movement or complete immobility of one or both vocal folds.[2] This condition can manifest clinically as hoarseness of voice and swallowing difficulties, significantly impacting a patient's quality of life and recovery.[1,2]

VFMI has been identified as a potential risk factor for increased morbidity and mortality, primarily due to its association with an elevated risk of pulmonary aspiration.[3] Reported incidence rates of VFMI following cardiac surgeries range from 1% to 2%.[4]

Traditionally, flexible fiberoptic endoscopy and videofluorographic swallowing studies have been the standard techniques for

*Department of Adult Critical Care, Aswan Heart Centre, Magdi Yacoub Foundation, Aswan, Egypt*

**Address for correspondence:**
Eleia Mosaad, MD.
Department of Adult Critical Care, Aswan Heart Centre, Magdi Yacoub Foundation, Aswan, Egypt.
E-mail:
eleia.mosaad@gmail.com

**Received:** 23.08.2024
**Accepted:** 14.12.2024
**Published:** 31-12-2024

***How to cite this article:*** *Eltayeb S, Mosaad E. Safeguard the Airways: Detecting Post-Extubation Vocal Fold Motion Impairment Using Laryngeal Ultrasound: A Case Study. J Crit Intensive Care 2024;15(3):116—119.*

visualizing vocal fold mobility and diagnosing VFMI.[5] However, these methods require specialized equipment and expertise and may not be readily available in all healthcare settings.[5,6] In recent years, point-of-care ultrasound (POCUS) has emerged as a valuable tool for airway assessment and guiding interventions, including evaluating vocal fold function.[6,7] POCUS offers a more accessible and portable option for clinicians to monitor vocal fold motion and guide patient management.[8] We present the case of a 21-year-old patient who was found to have unilateral vocal fold paralysis as detected by ultrasound.

## Case Report

A 21-year-old female patient with a body mass index (BMI) of 17 kg/m² and a history of chronic heart failure had undergone left ventricular assist device (LVAD) implantation several years prior. She was readmitted to our center, presenting with a focal neurological deficit and seizures caused by a left internal capsule ischemic infarction. A transesophageal echocardiogram revealed large vegetations on the mitral valve. A microbiological workup for infective endocarditis was initiated, and empirical broad-spectrum antimicrobial therapy was started. The patient subsequently developed progressive heart failure symptoms, persistent fever, and respiratory failure. Further microbiological testing confirmed a superimposed chest infection caused by Klebsiella pneumoniae, necessitating a few days of intubation and mechanical ventilation. Following a multidisciplinary team meeting, a decision was made to proceed with surgery for her complicated case of unresolving infective endocarditis.

Upon admission to the intensive care unit (ICU), her Acute Physiology and Chronic Health Evaluation II (APACHE II) score was 10, indicating a 15% risk of mortality. During the preoperative airway assessment, the Mallampati classification was used to predict intubation difficulty, and her Mallampati score was I.

The patient underwent a redo sternotomy for mitral valve replacement. She was successfully extubated on the third postoperative day but subsequently developed hoarseness of voice and exhibited signs of aspiration to fluids. Her hemodynamics remained stable, and oxygen therapy was not required. An intensivist performed a laryngeal ultrasound (LUS) to provide real-time visualization of the vocal folds using a Philips EPIQ CV x3D* system with a linear high-frequency ultrasound probe. The sonographic examination was conducted with the patient in a supine position and her neck extended. The vocal folds were scanned in a transverse midline view. The patient was instructed to speak and take deep inspiration. The ultrasound examination revealed reduced excursion and limited adduction of the left vocal fold during phonation and deep inspiration, findings consistent with left vocal fold paresis (Figure 1). These findings were compared to the normal appearance of the vocal folds (Figure 2). This finding was consistent with the patient's clinical presentation and supported the diagnosis of post-extubation VFMI, indicating a high risk of aspiration pneumonitis.

We utilized the Adult Subjective Global Assessment Form to evaluate the risk of malnutrition, which indicated that our patient was at risk (Supplementary Material 1). A nasogastric (NG) tube was inserted to ensure adequate caloric intake and reduce the risk of aspiration. The diagnosis of VFMI was not confirmed by video laryngoscopy.

An ultrasound scan conducted ten days later showed improved vocal fold movement. The NG tube was re-


**Figure 1. Reduced movement and limited adduction of the left vocal fold during phonation. There is an apparent failure of complete adduction between the two vocal folds, with the left vocal fold displaced laterally, resulting in an asymmetrical appearance. (1) Muscles of the neck, (2) right vocal fold, (3) left vocal fold, and (4) thyroid cartilage.**

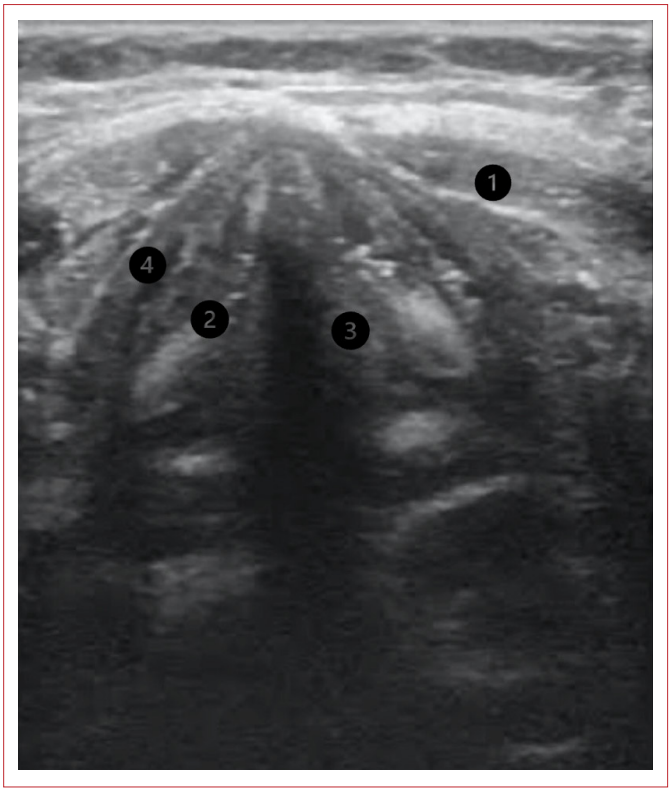


**Figure 2. Normal sonographic appearance of the vocal folds during inspiration, showing symmetry. (1) Muscles of the neck, (2) right vocal fold, (3) left vocal fold, (4) thyroid cartilage.**

moved, and the patient completed her rehabilitation program. She was transferred to the inpatient ward to complete six weeks of intravenous (IV) antibiotics as per the infective endocarditis protocol and was subsequently discharged home. She was referred to a phonetic specialist for follow-up after discharge.

Written informed consent was obtained from the patient for the publication of this case report.

## Discussion

Vocal fold motion impairment is a rare but serious consequence of tracheal intubation. VFMI limits nutritional intake and increases the risk of aspiration pneumonia.[1] The incidence of postoperative VFMI varies across studies due to the heterogeneity of surgical procedures and diagnostic modalities used to detect VFMI.[1,3] Multiple risk factors have been identified for postoperative vocal fold motion impairment, including advanced age, comorbidities such as hypertension and diabetes, prolonged surgical duration, and the sitting posture during surgery.[1,3] Iatrogenic VFMI has been documented in procedures involving the thyroid gland, cervical spine, thoracic region, and cardiac surgeries.[1,3] Mechanisms leading to VFMI after cardiac surgeries may include hyperextension of the neck, traumatic intubation, or direct trauma to the recurrent laryngeal nerve.[4] In this case, repeated intubations due to heart failure and chest infections prior to surgery may have further increased the risk for the patient.[9]

While video fluorographic and nasal endoscopic examinations are considered the gold-standard diagnostic tools for VFMI, bedside ultrasound has emerged as an essential tool for airway management.[7] Laryngeal ultrasound, in particular, has been described as an airway ultrasound modality used to visualize and assess the mobility of the vocal folds.

Two recent studies have demonstrated the high diagnostic accuracy of LUS for VFMI in children following cardiac surgery.[6,10] A recent systematic review and meta-analysis in adults reported similar findings, with a pooled sensitivity for LUS of 0.95 (95% confidence interval [CI]: 0.89–0.98) and a specificity of 0.98 (95% CI: 0.96–0.99).[8] Laryngeal ultrasound relies on visualizing the vibratory movement of both vocal folds during phonation. The larynx is typically visualized at the level of the thyroid cartilage, which serves as an anatomical landmark. The literature reveals variability in the preferred patient position for examination. Some practitioners conduct the procedures with patients in a supine position, while others prefer the sitting position. There is also diversity in the probe's orientation, with both long-axis and short-axis orientations described in the literature.[5]

Our patient was at a high risk of malnutrition due to a profound catabolic state and pulmonary aspiration, which could have further complicated her postoperative recovery. Early detection of VFMI was, therefore, critical. The management of postoperative VFMI is primarily conservative, focusing on ensuring adequate nutritional intake and preventing aspiration. Daily assessments by bedside nurses and rehabilitation teams are essential for monitoring phonation and swallowing. In some cases, voice therapy, medialization injections, or surgery may be indicated for persistent mobility disorders.[11] Repeated ultrasound examinations can be utilized for bedside monitoring and follow-up; this method has been deemed reliable and safe. However, further large-scale studies are required in this field.

## Conclusion

Laryngeal ultrasound is a safe, reliable, and repeatable tool for the early detection and monitoring of VFMI in symptomatic patients following extubation. It can also serve as a screening tool for patients at high risk of VFMI, thereby reducing the risk of post-extubation aspiration.

**Informed Consent:** Written informed consent was obtained from the patient for the publication of this case report.
**Peer-review:** Externally peer-reviewed.
**Author Contributions:** Concept – S.E.; Design – S.E.; Supervision – S.E., E.M.; Materials – S.E.; Data Collection and/or Processing - S.E.; Analysis and/or Interpretation - E.M.; Literature Review – E.M.; Writing – S.E., E.M.; Critical Review – S.E., E.M.
**Use of AI for Writing Assistance:** The authors declare that they did not use artificial intelligence (AI)-assisted technologies (such as large language models [LLMs], chatbots, or image generators) in the production of this submitted work.
**Conflict of Interest:** The authors have no conflicts of interest to declare.
**Funding:** The authors declared that this study received no financial support.

## References

1. Kikura M, Suzuki K, Itagaki T, Takada T, Sato S. Age and comorbidity as risk factors for vocal cord paralysis associated with tracheal intubation. Br J Anaesth 2007;98(4):524—30. [CrossRef]
2. Rosenthal LH, Benninger MS, Deeb RH. Vocal fold immobility: a longitudinal analysis of etiology over 20 years. Laryngoscope 2007;117(10):1864—70. [CrossRef]
3. Lim S, Kim DC, Cho K, et al. Vocal cord paralysis following general anesthesia with endotracheal intubation: a clinical review on 43 cases. Anesth Pain Med (Seoul) 2020;15(2):226—32. [CrossRef]
4. Hamdan AL, Moukarbel RV, Farhat F, Obeid M. Vocal cord paralysis after open-heart surgery. Eur J Cardiothorac Surg 2002;21(4):671—4. [CrossRef]
5. Maeda K, Nagasaka M, Nagano A, et al. Ultrasonography for Eating and Swallowing Assessment: A Narrative Review of Integrated Insights for Noninvasive Clinical Practice. Nutrients 2023;15(16):3560. [CrossRef]
6. Izadi S, Zendejas B, Meisner J, et al. Diagnostic Accuracy of Laryngeal Ultrasound for Evaluating Vocal Fold Movement Impairment in Children. J Pediatr Surg 2024;59(1):109—16. [CrossRef]
7. Austin DR, Chang MG, Bittner EA. Use of Handheld Point-of-Care Ultrasound in Emergency Airway Management. Chest 2021;159(3):1155—65. [CrossRef]
8. Su E, Hamilton C, Tawfik DS, et al.; Pediatric Research Collaborative for Critical Ultrasound. Laryngeal Ultrasound Detects Vocal Fold Immobility in Adults: A Systematic Review. J Ultrasound Med 2022;41(8):1873—88. [CrossRef]
9. Campbell BR, Shinn JR, Kimura KS, et al. Unilateral Vocal Fold Immobility After Prolonged Endotracheal Intubation. JAMA Otolaryngol Head Neck Surg 2020;146(2):160—7. [CrossRef]
10. Siu JM, Colyer J, Horner C, et al. Ultrasound Screening After Cardiac Surgery Shows Vocal Fold Impairment and Predicts Aspiration. Laryngoscope 2024;134(4):1939—44. [CrossRef]
11. Young VN, Smith LJ, Rosen C. Voice outcome following acute unilateral vocal fold paralysis. Ann Otol Rhinol Laryngol 2013;122(3):197—204. [CrossRef]

MAGDI YACOUB
HEART FOUNDATION
ASWAN HEART CENTRE

Patient Label

# ADULT SUBJECTIVE GLOBAL ASSESSMENT FORM

## Nutrient intake

1. ☐ No change; adequate
2. Inadequate; duration of inadequate intake _____
   ☐ Suboptimal solid diet ☐ Full fluids or only oral nutrition supplements ☐ Minimal intake, clear fluids or starvation
3. Nutrient Intake in past 2 weeks
   ☐ Adequate_____ ☐ Improved but not adequate_____ ☐ No improvement or inadequate _____

## Weight

Usual weight_____ Current weight

1. Non fluid weight changes past 6 months Weight loss (kg) _____
   ☐ <5% loss or weight stability ☐ 5-10% loss without stabilization or increase ☐ >10% loss and ongoing

   If above not known, has there been a subjective loss of weight during the past six months?
   ☐ None or mild ☐ Moderate ☐ Severe
2. Weight change past 2 weeks Amount (if known) _____
   ☐ Increased ☐ No change ☐ Decreased

## Symptoms (Experiencing symptoms affecting oral intake)

1. ☐ Pain on eating ☐ Anorexia ☐ Vomiting ☐ Nausea ☐ Dysphagia ☐ Diarrhea
   ☐ Dental problems ☐ Feels full quickly ☐ Constipation
2. ☐ None ☐ Intermittent/mild/few ☐ Constant/severe/multiple
3. Symptoms in the past 2 weeks
   ☐ Resolution of symptoms ☐ Improving ☐ No change or worsened

## Functional capacity (Fatigue and progressive loss of function)

1. No dysfunction
2. Reduced capacity; duration of change _____
   ☐ Difficulty with ambulation/normal activities ☐ Bed/chair-ridden
3. Functional Capacity in the past 2 weeks
   ☐ Improved ☐ No change ☐ Decrease

## Metabolic requirement

High metabolic requirement ☐ No ☐ Yes

## Physical examination

| | | | |
|---|---|---|---|
| Loss of body fat | ☐ No | ☐ Mild/Moderate | ☐ Severe |
| Loss of muscle mass | ☐ No | ☐ Mild/Moderate | ☐ Severe |
| Presence of edema/ascites | ☐ No | ☐ Mild/Moderate | ☐ Severe |

## SGA RATING

| | | |
|---|---|---|
| **A** Well-nourished (Normal) | **B** Mildly/moderately malnourished (Some progressive nutritional loss) | **C** Severely malnourished (Evidence of wasting and progressive symptoms) |

## Contributing factors

☐ CACHEXIA - (fat and muscle wasting due to disease and inflammation) ☐ SARCOPENIA - (reduced muscle mass and strength)

| Nutrient intake assessment in last (24 hour) | | |
|---|---|---|
| Meal | Amount of Protien<br>How Prepared | Where eat |
| Breakfast | | |
| Lunch | | |
| Dinner | | |
| Snack | | |

| Nutrition Progress Note "repeated every 3\5\7day" | | |
|---|---|---|
| **Date \ Time** | **Nutritin Assessment** | **Care Plan** |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |

☐ Underweight ☐Mild Obesity (Obese 1)
☐ Normal ☐Modrate Obesity (Obese Type 2)
☐ Overweight ☐Morbid Obesity (Obese Type 3)

Estimated nutritional requirements

**BEE ( *Basel Energy Expenditure* )**

K Callory Activity Factor
Calories \ Kg : K Cal \Day
Protein \ Kg : Gm\ Kg
Fluid \ Intake : Normal Restricted
Maximum Allowed Intake
Current (Type And Volume)

**Diet Consistency For Oral Diet :**
Normal□ Semi Solid □ Soft□ Liquid□

**Mode Of Feeding**
NGT□ Gastrostomy□ IV Fluids □
PPN□ TPN □

**Type of diet:**
Normal □ Diabetics □
High Protein □ Renal □ other □

**Re Assessment Time Frame**
3 Days □ 5 Days □ 7 Days □ other □

## Labs

| Date | HGB | ALB | Urea | Creat | Na | K | pHos | ALT | AST | Mg |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |

# Subjective Global Assessment Guidance For Body Composition

## SUBCUTANEOUS FAT

| Physical Examination | Normal | Mild/Moderate | Severe |
|---|---|---|---|
| Under the eyes | Slightly bulging area | Somewhat hollow look, Slightly dark circles, | Hollowed look, depression, dark circles |
| Triceps | Large space between fingers | Some depth to fat tissue, but not ample. Loose fitting skin. | Very little space between fingers, or fingers touch |
| Ribs, lower back, sides of trunk | Chest is full; ribs do not show. Slight to no protrusion of the iliac crest | Ribs obvious, but indentations are not marked. Iliac Crest somewhat prominent | Indentation between ribs very obvious. Iliac crest very prominent |

## MUSCLE WASTING

| Physical examination | Normal | Mild/Moderate | Severe |
|---|---|---|---|
| Temple | Well-defined muscle | Slight depression | Hollowing, depression |
| Clavicle | Not visible in males; may be visible but not prominent in females | Some protrusion; may not be all the way along | Protruding/prominent bone |
| Shoulder | Rounded | No square look; acromion process may protrude slightly | Square look; bones prominent |
| Scapula/ribs | Bones not prominent; no significant depressions | Mild depressions or bone may show slightly; not all areas | Bones prominent; significant depressions |
| Quadriceps | Well defined | Depression/atrophy medially | Prominent knee, Severe depression medially |
| Interosseous muscle between thumb and forefinger (back of hand)** | Muscle protrudes; could be flat in females | Slightly depressed | Flat or depressed area |

## FLUID RETENTION

| Physical examination | Normal | Mild/Moderate | Severe |
|---|---|---|---|
| Edema | None | Pitting edema of extremities / pitting to knees, possible sacral edema if bedridden | Pitting beyond knees, sacral edema if bedridden, may also have generalized edema |
| Ascites | Absent | Present (may only be present on imaging) | |

A - Well-nourished no decrease in food/nutrient intake; < 5% weight loss; no/minimal symptoms affecting food intake; no deficit in function; no deficit in fat or muscle mass OR *an individual with criteria for SGA B or C but with recent adequate food intake; non-fluid weight gain; significant recent improvement in symptoms allowing adequate oral intake; significant recent improvement in function; and chronic deficit in fat and muscle mass but with recent clinical improvement in function.

B - Mildly/moderately malnourished definite decrease in food/nutrient intake; 5% - 10% weight loss without stabilization or gain; mild/some symptoms affecting food intake; moderate functional deficit or recent deterioration; mild/moderate loss of fat and/or muscle mass OR *an individual meeting criteria for SGA C but with improvement (but not adequate) of oral intake, recent stabilization of weight, decrease in symptoms affecting oral intake, and stabilization of functional status.

C - Severely malnourished severe deficit in food/nutrient intake; > 10% weight loss which is ongoing; significant symptoms affecting food/ nutrient intake; severe functional deficit OR *recent significant deterioration obvious signs of fat and/or muscle loss.

Cachexia – If there is an underlying predisposing disorder (e.g. malignancy) and there is evidence of reduced muscle and fat and no or limited improvement with optimal nutrient intake, this is consistent with cachexia.

Sarcopenia – If there is an underlying disorder (e.g. aging) and there is evidence of reduced muscle and strength and no or limited improvement with optimal nutrient intake.