



## Breathlessness Caused by Rheumatoid Arthritis: Laryngeal Origin Diagnosed Using Dynamic 320-slice CT Larynx

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### Abstract:

Rheumatoid arthritis (RA) can affect any synovial joint including laryngeal joints. The disease is usually diagnosed clinically but the 'gold standard' for diagnosing laryngeal RA is laryngoscopy. The procedure is semi-invasive, requires a skilled operator, specialised equipment and is often not performed. In this case study, we demonstrate for the first time that fixed vocal cord narrowing in a patient with RA who presented with breathlessness and can be diagnosed by means of novel non-invasive methodology: dynamic 320-slice multi-detector CT (320-MDCT) larynx. CT studies revealed abnormal adduction and fixation of the vocal cords and supported a strong presumptive diagnosis of RA larynx in the absence of other causes. This advanced imaging modality may be valuable for simple, non-invasive evaluation of laryngeal function in RA, to monitor progression of disease and for follow-up of patients with RA larynx.

**Key words:** Arthritis, Joints, Dyspnea, Larynx, Vocal Cords, Humans.

### Introduction

Rheumatoid arthritis (RA) is an autoimmune disease that involves synovial joints. The larynx may be affected in approximately 25% of patients [1] and it is important to detect laryngeal involvement as early as possible to minimise potential debilitating complications such as stridor, breathlessness and aspiration as the disease progresses [2]. The cricoarytenoid joint is usually involved leading to reduced vocal cord mobility and fixed adduction; abnormalities causing chiefly voice problems [3]. Importantly, in the absence of lung fibrosis causing dyspnoea in RA, laryngeal RA as an alternative

reason for breathlessness may not be investigated and escape detection [4].

Diagnosis of laryngeal RA is made using laryngoscopy [5]. The procedure can be testing since it requires a skilled operator and specialised equipment and is often not done due to a lack of access [6] or because other RA complications are given priority. Recently the dynamic 320-slice computerised tomography (CT), a novel imaging technique, has become widely available and in Australia there are more than thirty 320-slice multi-detector CTs

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(320-MDCT) installed. The CT technique enables 4-dimensional dynamic viewing of body structures over an anatomical length of approximately 16 cm, and therefore, allows functional imaging of entire organs such as heart, brain, joints and larynx over time [7]. We have recently used it to demonstrate vocal cord dysfunction [8], excessive dynamic airway collapse [9] and to diagnose vocal cord paralysis [10].

In this report, we detail a patient presenting with breathlessness and vocal cord narrowing associated with RA. The putative laryngeal origin of symptoms was diagnosed using dynamic 320-MDCT. This novel imaging technique can potentially simplify diagnosis, track progression and gauge treatment responses in RA complicated by laryngeal involvement.

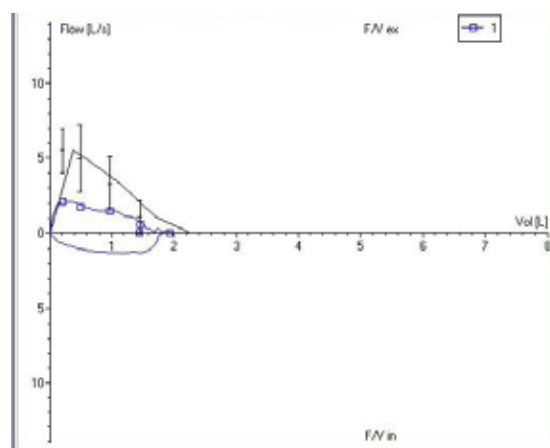
## Case Report

A 73 year-old non-smoking female with severe deforming RA presented with slowly progressive breathlessness. The patient had no history of cough or sputum, wheezing or previous chest disease. She denied changes in voice. There was a history of symptoms of heart failure, prior pulmonary involvement and lung fibrosis associated with RA. Clinical examination revealed evidence of RA but there were no signs of lung involvement with absence of crackles or other abnormalities. The patient's voice was normal. Oxygen saturation was 94%.

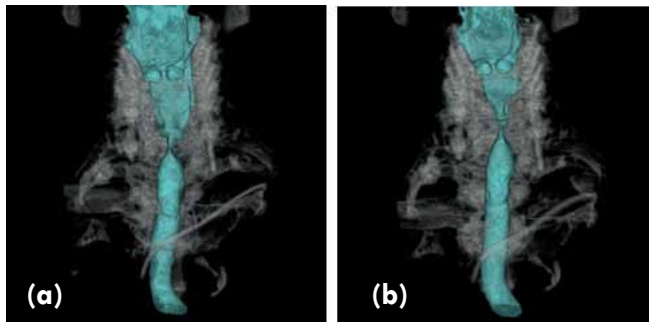
Pulmonary function testing showed that forced expiratory volume-1-second (FEV1) had decreased from 78% to 58% (predicted) over a two year period but with stable forced vital capacity (FVC) measurements. Inspiratory stridor was observed during the FVC manoeuvre. Both inspiratory and expiratory limbs of the flow volume loop were flattened and fixed extra-thoracic obstruction was suspected [Fig.1].

Non-contrast dynamic 320-slice CT larynx and trachea was performed which demonstrated marked and persistent adduction of the vocal cords during both inspiration and expiration. The vocal cords showed a clear lack of lateral mobility and appeared to be in a fixated position. RA involvement of the larynx was suspected [Fig.2]. To evaluate these abnormalities fiberoptic laryngoscopy (the 'gold standard') was done. This confirmed limited abduction of the vocal cords and images at endoscopy were identical to virtual endoscopy reflecting images generated from the CT dataset [Fig.3].

A presumptive diagnosis of laryngeal RA was made. To assess the effects of anti-inflammatory medication on the laryngeal abnormality, the patient was treated with prednisolone 30 mg daily for two weeks. Repeat evaluations found no appreciable differences in vocal cord movement and position after treatment (not shown). Spirometry was also unchanged.



**Fig.1:** Flow/Volume Loop of patient with laryngeal Rheumatoid Arthritis where ventilatory function is within normal limits. Fixed upper-airway obstruction (intra-thoracic and extra-thoracic) is observed which is consistent with a flattened inspiratory and expiratory flow-volume loop.

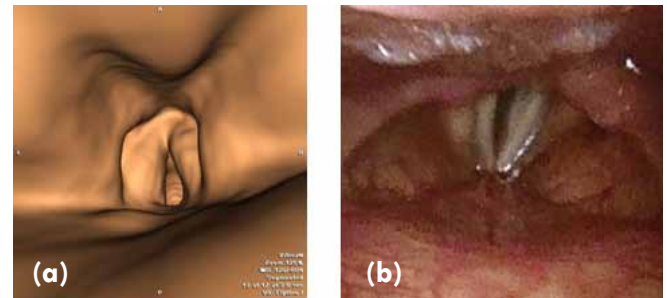


**Fig.2:** Non contrast dynamic 4-dimensional CT of larynx with coronal volume rendering reconstruction demonstrated very narrowed laryngeal lumen at the level of vocal cords throughout the breathing cycle. The laryngeal lumen only improved marginally during inspiration (Fig.2a) as compared to the expiration (Fig.2b).

## Discussion

Rheumatoid Arthritis (RA) is a damaging systemic disease that affects approximately 3% of the adult population [1]. The reported prevalence of laryngeal manifestations of RA in the 1960s was approximately 31% [3] but this has increased due to an improved awareness of laryngeal involvement in patients with RA [5].

Laryngeal RA is often not diagnosed in the initial stages and a high degree of suspicion is required [5]. It can lead to loss of voice and may even be life-threatening if causing severe airway obstruction [5]. Classical symptoms in laryngeal RA are dyspnoea, stridor, foreign body sensation and hoarseness [2]. Crico-arytenoid joint involvement with fixation or immobility of the vocal folds is also often present. Importantly, post-mortem histological examination reveals laryngeal involvement in up to 90% of patients with RA [2]. It suggests that current clinical and diagnostic approaches are not sufficient to detect and diagnose laryngeal RA and emphasised the need for more rapid, non-invasive diagnosis.



**Fig.3:** Non contrast dynamic 4-dimensional CT of larynx with virtual endoscopy view created confirmed very narrowed laryngeal lumen at the level of vocal cords throughout the breathing cycle (Fig.3a). This can be compared to the image taken via the 'gold standard' of fibre-optic laryngoscopy (Fig.3b). It can be seen that both images are identical in assisting with the evaluation of laryngeal rheumatoid arthritis.

Laryngoscopy under local anaesthetic or rarely bronchoscopy under general anaesthetic is used to diagnose laryngeal involvement in RA [7]. However, these methods are invasive and use of alternative technologies such as dynamic CT with conventional 64-slice multi-detector CT (64-MDCT) scanners or magnetic resonance imaging (MRI) have been considered. It has been estimated that in up to 70% of cases, these methods could speed up diagnosis of laryngeal abnormalities [2]. However, there are constraints since conventional 64-MDCT provides limited dynamic coverage of the larynx (4 cm). 320-MDCT enables dynamic 'cine' viewing of the upper airway over 16 cm as an ideal non-invasive procedure because of its superior spatial and temporal resolution. We have reported use of this technology in vocal cord dysfunction (VCD) [8], idiopathic bilateral vocal cord paralysis (VCP) [8] and to detect excessive dynamic airway collapse (EDAC) [9].

In this report, we confirm utility of 4-dimensional dynamic volume 320-MDCT in laryngeal RA. Both volumetric analyses and virtual endoscopy studies

were able to detect restricted laryngeal movement and demonstrate abnormality in vocal cord position and excursion. Our report therefore suggests that physicians and rheumatologists may utilise 320-MDCT as a non-invasive technique to evaluate patients with RA to enable accurate detection of laryngeal involvement, even at an early stage [2]. Given that 320-MDCT is now widely available, this method may become the preferred future diagnostic option. Further studies to determine diagnostic accuracy of dynamic CT and to examine use of CT versus fibre-optic laryngoscopy are merited.

In conclusion, the laryngeal manifestations of RA are frequently undiagnosed and not investigated. We demonstrate that dynamic volume 320-MDCT of larynx provides a simple, non-invasive and clinically applicable method to diagnose laryngeal involvement in RA.

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