Cadaveric position of unilateral vocal cord: a case of cricoid fracture with ipsilateral arytenoid dislocation

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ABSTRACT

We report a case of cricoid cartilage fracture with unilateral arytenoid dislocation following a motorcycle accident. This 25 year old male sustained blunt injury to the head, face and neck. He presented late to the hospital with one week history of dysphonia. Laryngoscopy revealed cadaveric position of the non-functioning left vocal cord. CT and MRI showed laterally displaced left vocal cord. Displaced fractures were noted in the cricoid at the junction of lamina with the anterior arch on the left side and at the right side of the anterior arch, along with dislocated left arytenoid resulting in ipsilateral vocal cord palsy. Medialization thyroplasty was performed to improve his phonation. Laryngeal trauma warrants close monitoring because of the risk of airway compromise. Radiologists play a crucial role in early diagnosis and should always have high index of suspicion. Recognition of laryngeal injury is important for initial resuscitation as well as for long term airway and vocal function.

CASE REPORT

CASE REPORT

A 25 years old male presented to the ENT department with one week history of dysphonia. He was involved in a motorcycle accident sustaining abrasions to his forehead, right side of the chest and was not sure of injuring his neck. Although upon further questioning he was able to recollect hitting his neck onto the metal crossbar in the handle of the lightweight motorcycle. There was no history of loss of consciousness, vomiting or ear, nose and throat bleeding. On physical examination, a small non-tender swelling was noted to the right of the midline on the anterior aspect of the neck just below the thyroid cartilage prominence.

Video laryngoscopy showed paralyzed left vocal cord lying in a cadaveric (lateral) position [Fig 1].

Plain radiograph of the cervical spine was essentially normal [Fig 2]. CT scan of the neck showed displaced fractures involving the cricoid cartilage [Fig. 3A] at the junction of the lamina with the anterior arch on the left side and on the right side of the anterior arch resulting in disruption of the cricoid ring [Fig. 5A,5B]. Superior displacement of the left arytenoid was noted suggesting dislocation [Fig. 3B]. Anterior displacement was noted involving the right half segment of the fractured cricoid ring resulting in a small swelling noted on physical examination. The left aryepiglottic fold was thickened [Fig. 4A,6A]. The left vocal cord was laterally displaced [Fig. 4B]. Rest of the larynx appeared normal. Contrast-enhanced CT was not contributory. Arytenoids were not visualized in the MRI scan but it demonstrated laterally placed left vocal cord, thickening of the left aryepiglottic fold and cricoid fractures with adjacent edema [Fig. 7]. He underwent Medialization thyroplasty, a phonosurgical procedure for voice augmentation.

DISCUSSION

Laryngeal fractures may be due to blunt or penetrating injury and can be categorized as either high or low velocity.

Vocal cord paralysis can be either unilateral or bilateral. It results from dysfunction of the recurrent laryngeal or the vagus nerve and from mechanical derangement of the larynx. The most common cause is surgical iatrogenic injury (44%). Other causes include malignancies (17%), endotracheal intubation (15%), neurologic diseases (12%), idiopathic causes (12%), blunt or penetrating trauma to the neck, viral infection, inflammation (involving larynx or cricoarytenoid joint), radiation injury, metabolic causes and toxins [1].

Motor vehicle accidents are the most common cause of blunt injury. The typical injury mechanism being described is one where the larynx in a hyper extended neck is compressed directly against the steering wheel or dashboard or the metal cross bar in a motorcycle. Other causes of blunt injury include direct blows sustained during assaults, sport injuries, hanging, manual strangulation and iatrogenic causes.

Strangulation type injuries typically cause cartilage fracture without mucosal lacerations. Associated arytenoid cartilage dislocation and recurrent laryngeal nerve injury can occur. The clothesline injury is one of the most severe forms of blunt trauma to the larynx. This occurs when the individual riding a motorcycle strikes his neck against a stationary object such as a wire fence or tree limb. This can result in cricotracheal separation.

Gunshot or knife wounds are the primary causes of penetrating injuries.

Unilateral vocal fold paralysis results in glottic incompetence, either partial or complete, resulting in a weak or absent vocal fold vibration leading to dysphonia.

Laryngeal fracture, a rare potentially life-threatening injury accounts for <1% of all blunt traumas [2]. Its incidence varies with the sample size and geographic locality.

Bent et al reported an incidence of 1/5000 emergency department visits in 1987 for both blunt and penetrating laryngeal injuries, while Schaefer reported an incidence of 1/30 000 emergency department visits over a 27-year period for blunt injuries alone [3,4]. Jewett et al in their series reported the incidence of external laryngeal trauma as 1 per 137 000 inpatient visits and noted that males (77% vs 33%) were more prone for traumatic laryngeal injuries [5]. The associated mortality rate with this injury is about 2% [5]. Females with slender, long neck are highly susceptible to laryngeal injury, particularly in supraglottic region.

Isolated cricoid injury accounts for less than 50% of all laryngeal traumas [6].

Arytenoid dislocation and arytenoid subluxation are extremely rare. It results in reduced mobility of the true vocal fold and incomplete glottic closure mimicking true vocal fold paralysis. Its incidence is not known. About 104 cases of arytenoid dislocation have been reported in literature, based on a contemporary literature review by Norris BK et al on arytenoid dislocation in January 2011 [7]. Arytenoid dislocations are reported to occur in 0.1% of tracheal intubations [8]. There is no age or sex predilection. Associated anomalies like laryngomalacia, acromegaly etc can weaken the cricoarytenoid joint.

Intubation trauma is the most common etiology for arytenoid subluxation. Blunt and penetrating neck trauma is less common causes [8].

Clinical presentation is common to arytenoid subluxation/dislocation and vocal fold paralysis. Reduced vocal fold mobility, arytenoid edema and loss of arytenoid symmetry are the signs noted upon laryngoscopy in acute arytenoid subluxation [9]. Poor glottic closure and malalignment of the true vocal folds are often noted.

CT scan is the technique of choice for evaluating larynx. Until now, MRI has not been shown to be superior to CT scan in evaluating the arytenoid-cricoid interface and other laryngeal structures.

Typical CT scan findings of arytenoid subluxation include displacement of the arytenoid body, altered angulation of the aryepiglottic fold and widening of the ventricle on the affected side [10]. Patients with vocal cord paralysis may demonstrate a slight rotation and displacement of the arytenoid, but not to the degree that is evident with arytenoid subluxation/dislocation.

Visualization of the laryngeal cartilages by CT scan is limited by the degree of mineralization, especially in paediatric population.

In our case, CT scan shows superior displacement with rotation of the left arytenoid and thickening of the left aryepiglottic fold (Fig. 3B,4A), features consistent with arytenoid dislocation.

Anatomically the larynx is guarded by the mandible, sternum, sternocleidomastoid muscles (aiding neck flexion) and the rigid cervical spine posteriorly accounting for the rarity of this injury. All muscles of the larynx are supplied by the recurrent laryngeal nerve except cricothyroid which is innervated by the external laryngeal nerve.

With complete recurrent laryngeal nerve paralysis the vocal cord takes up a paramedian position. With complete paralysis of both the recurrent laryngeal nerve and the external laryngeal nerve the vocal cords takes a more lateral cadaveric position which is also seen with arytenoid dislocation [11].

The differential diagnosis for acute unilateral vocal fold paralysis includes recent upper respiratory tract viral infection and recent intubation for any surgical procedure.

In our case, the left vocal cord assumes a lateral cadaveric position (Fig. 4B,7A,7B) making both arytenoid dislocation and paralysis of both the recurrent laryngeal nerve and the external laryngeal nerve (external branch of the superior laryngeal nerve) as the differentials. But it is highly unlikely for both the nerves to be paralyzed in this scenario. With history of blunt injury to the neck and CT examination demonstrating left arytenoid dislocation, we believe left arytenoid dislocation as the cause for left vocal cord paralysis in this case.

Medical management has little role in the treatment of patients with unilateral vocal fold paralysis. Surgery includes temporary or permanent procedure aimed at restoring glottic competence. Temporary measures include endoscopic vocal fold injections while permanent treatment includes procedures like laryngeal framework surgery, medialization laryngoplasty (type 1 thyroplasty) and arytenopexy [12, 13].

Our patient underwent medialization thyroplasty. This procedure is ideally performed under local infiltration anesthesia wherein the paralyzed vocal cord is surgically medialized in an attempt to improve the phonation [14].

TEACHING POINT

High index of suspicion and early recognition is crucial in the management of patients with cricoid cartilage fracture and arytenoid dislocation. Of various imaging modalities, laryngeal skeleton, especially the cartilages are best studied by CT imaging.

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FIGURES

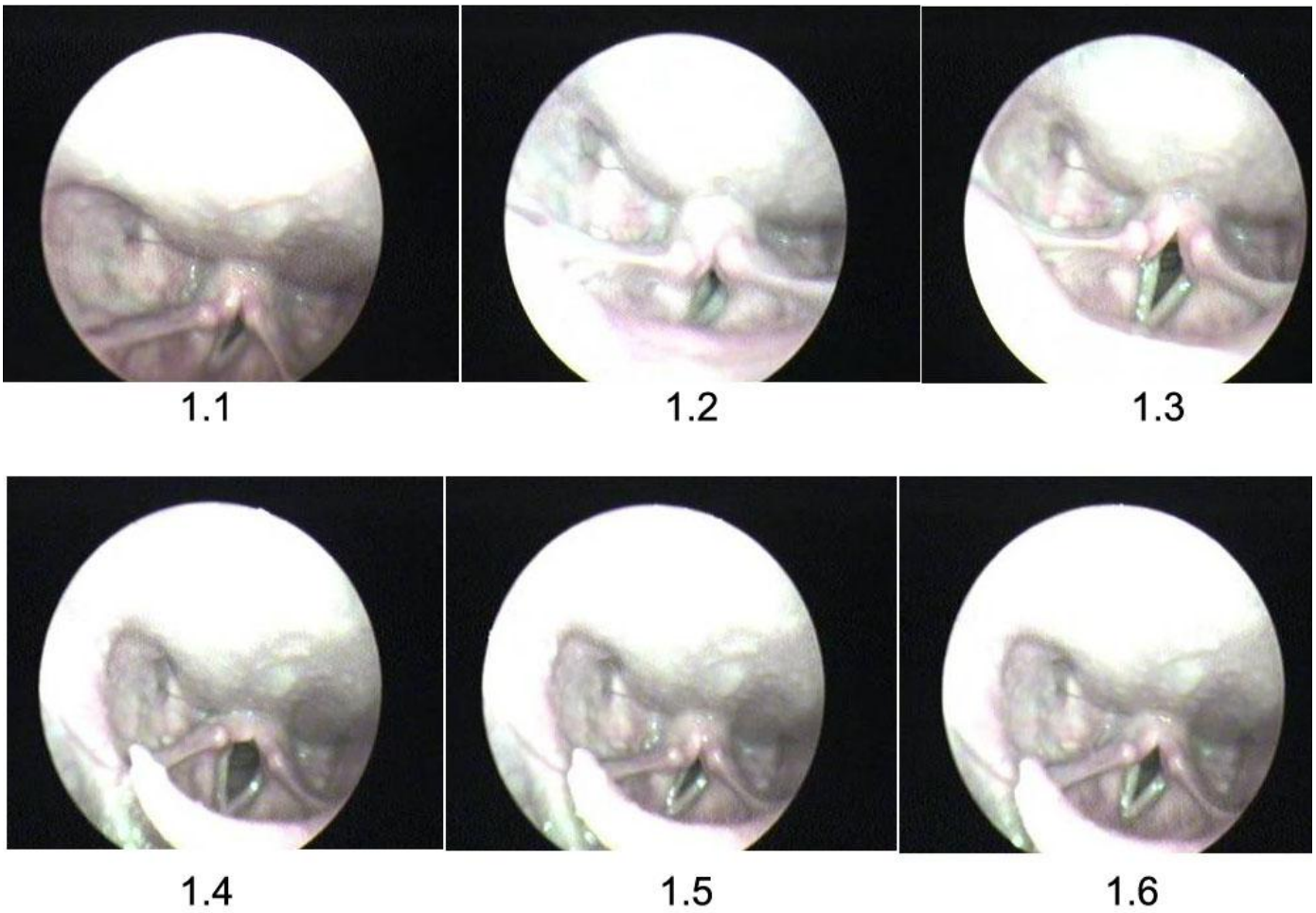

Figure 1: 25 year old male with cricoid fractures and dislocated left arytenoid causing ipsilateral vocal cord paralysis. Video laryngoscopy images shows paralyzed left vocal cord lying in a cadaveric (lateral) position.

Figure 2 (left): 25 year old male with cricoid fractures and dislocated left arytenoid causing ipsilateral vocal cord paralysis. Plain radiograph lateral projection of the cervical spine shows no abnormality.

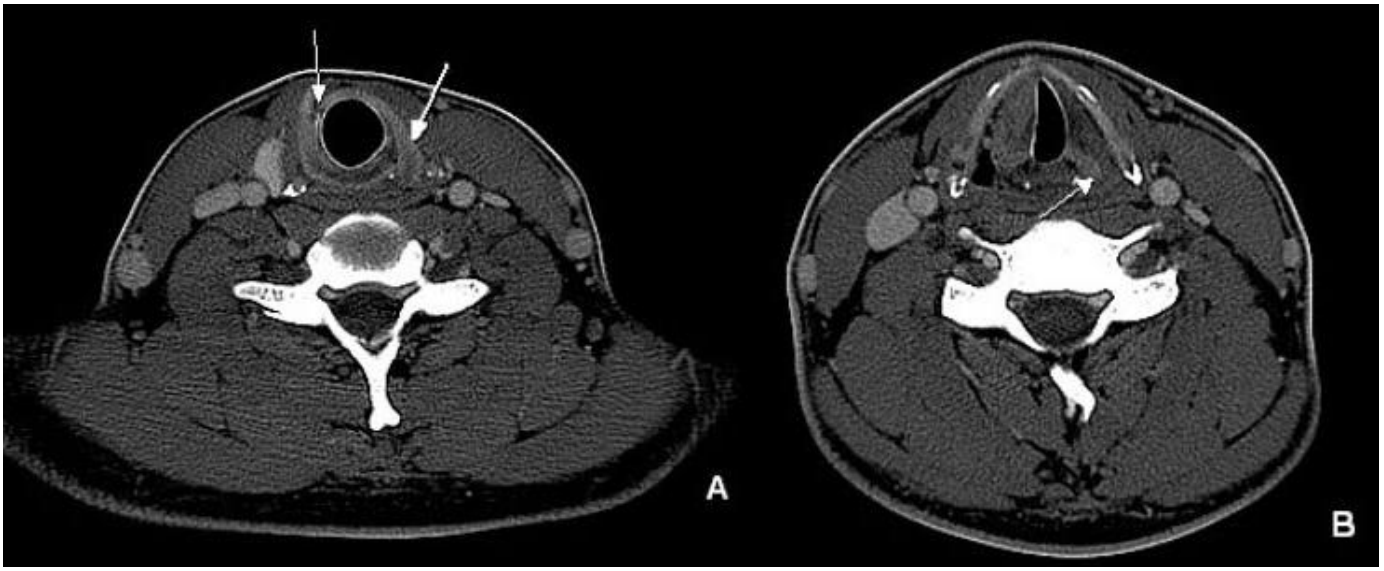

Figure 3: 25 year old male with cricoid fractures and dislocated left arytenoid causing ipsilateral vocal cord paralysis. 3A) Contrast-enhanced CT axial section of the neck (bone window) shows cricoid fracture involving the anterior aspect on the right side (thin arrow) and at the junction of lamina with the arch on the left side (thick arrow). Fracture fragments appear displaced. 3B) Contrast-enhanced CT axial section of the neck (bone window) shows dislocated left arytenoid displaced superiorly (arrow) (Hitachi Eclos 8 slice CT scanner; Protocol: 250 mAs, 120kV, 2.5mm slice thickness)

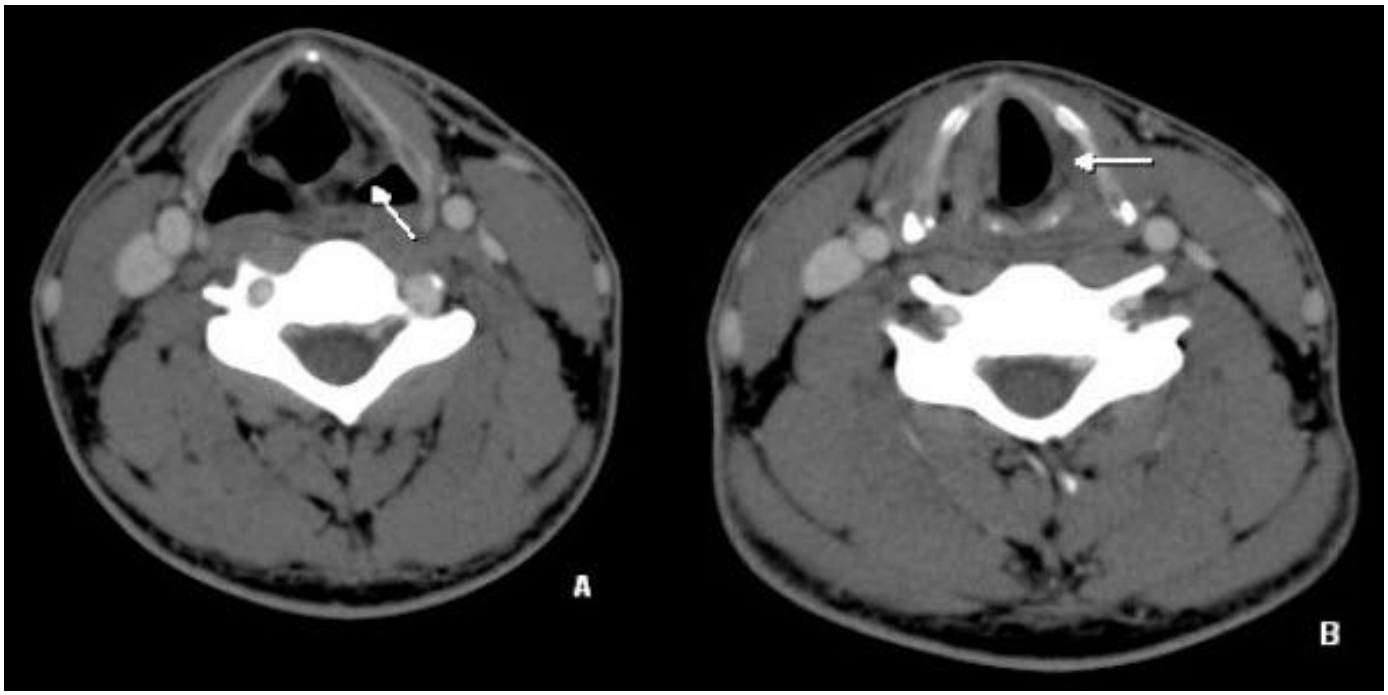

Figure 4: 25 year old male with cricoid fractures and dislocated left arytenoid causing ipsilateral vocal cord paralysis. 4A) Contrast-enhanced CT axial section of the neck shows thickened left aryepiglottic fold (arrow). 4B) Contrast-enhanced CT axial section of the neck shows laterally displaced left vocal cord (arrow) (Hitachi Eclos 8 slice CT scanner; Protocol: 250 mAs, 120kV, 2.5mm slice thickness, 50ml of nonionic contrast medium)

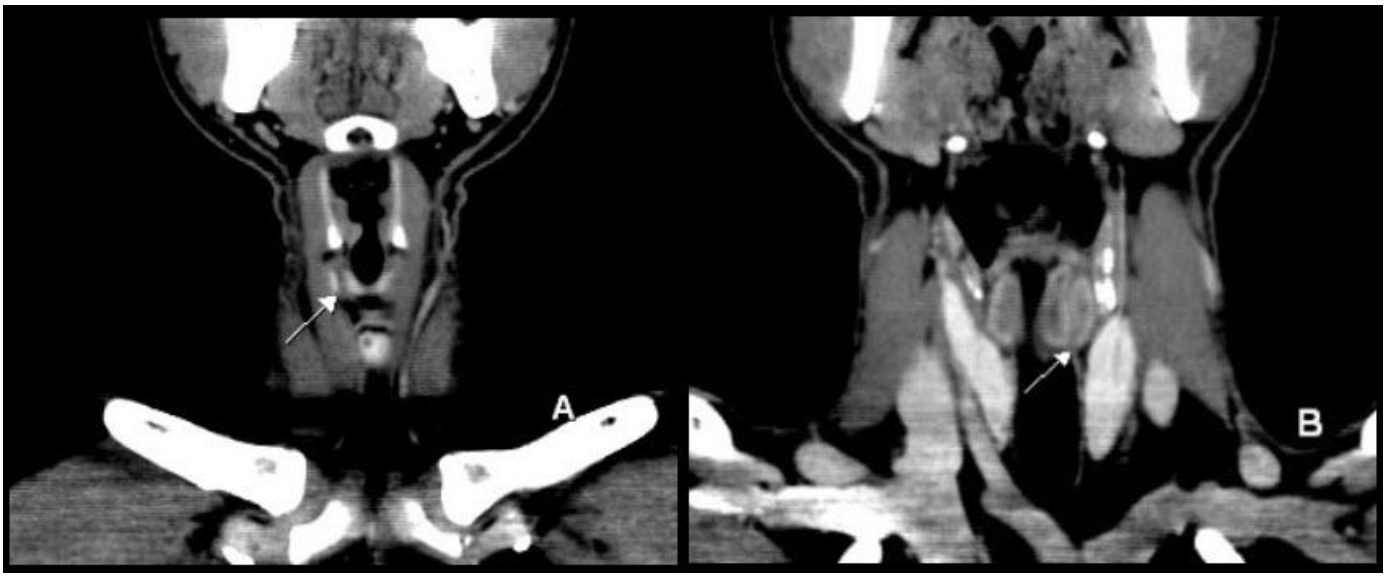

Figure 5: 25 year old male with cricoid fractures and dislocated left arytenoid causing ipsilateral vocal cord paralysis. 5A) Contrast-enhanced CT coronal section (Multi Planar Reconstruction) of the neck shows cricoid fracture (arrow) at the anterior aspect on right side. 5B) Contrast-enhanced CT coronal section (Multi Planar Reconstruction) of the neck shows cricoid fracture (arrow) posteriorly at the junction of lamina and arch on the left side. (Hitachi Eclos 8 slice CT scanner; Protocol: 250 mAs, 120kV, 1.2mm slice thickness, 50ml of nonionic contrast medium)

Figure 6 (left): 25 year old male with cricoid fractures and dislocated left arytenoid causing ipsilateral vocal cord paralysis. 6A) Plain CT coronal section (Multi Planar Reconstruction) of the neck shows left aryepiglottic fold thickening (arrow). (Hitachi Eclos 8 slice CT scanner; Protocol: 250 mAs, 120kV, 1.2mm slice thickness)

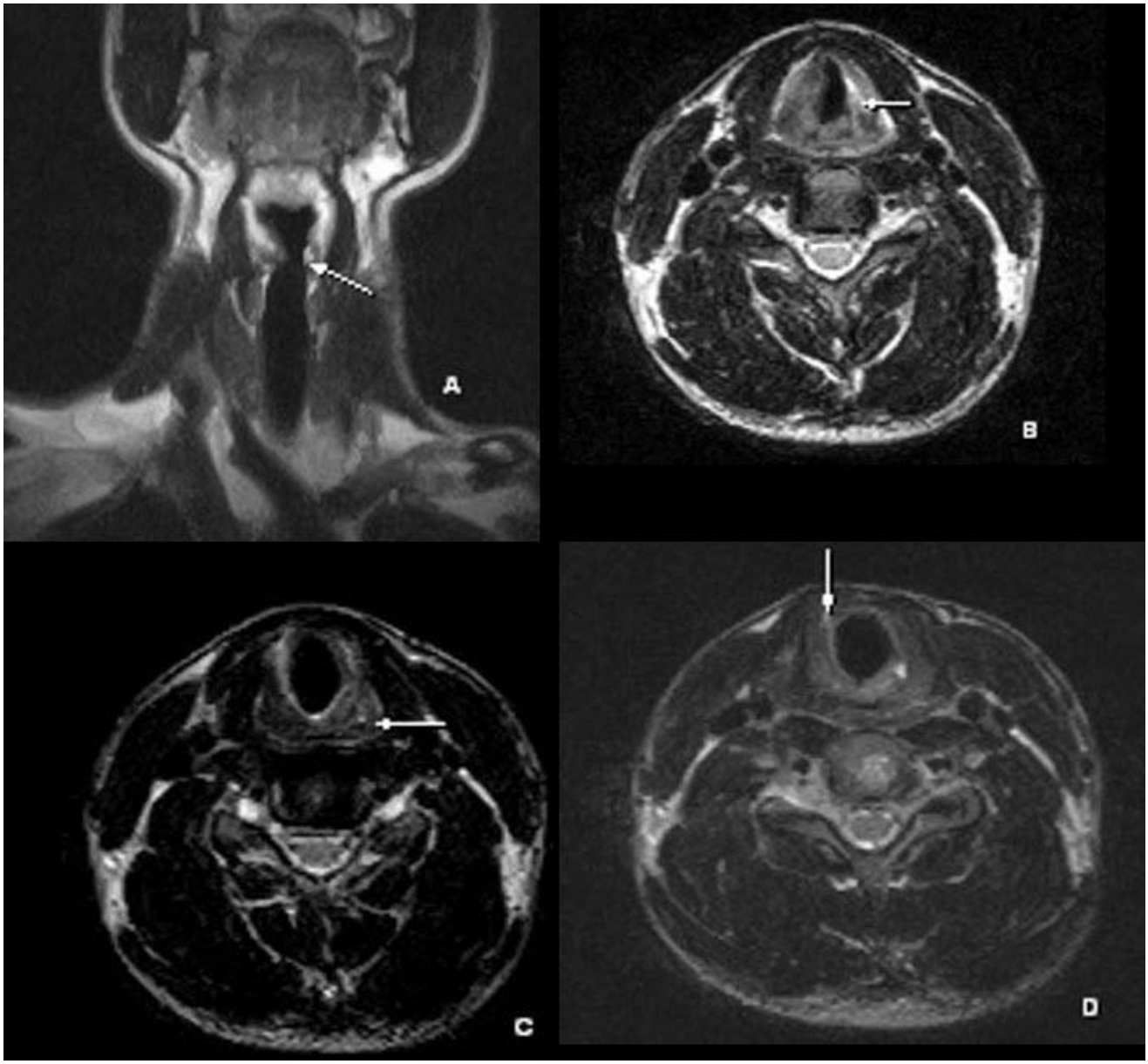

Figure 7: 25 year old male with cricoid fractures and dislocated left arytenoid causing ipsilateral vocal cord paralysis. Hitachi Aperto 0.4 Tesla MR scanner. 7A) T2 weighted spin echo sequence image (TR=3600; TE=104), coronal section of the neck shows left vocal cord paralysis (arrow). 7B) T2 weighted spin echo sequence image (TR=6150; TE=100), axial section of the neck shows non-functioning left vocal cord in cadaveric (lateral) position (arrow). 7C) T2 weighted spin echo sequence image (TR=6150; TE=100), axial section of the neck shows cricoid fracture (arrow) on the left side at the junction of lamina and the arch. 7D) T2 weighted spin echo sequence image (TR=6150; TE=100), axial section of the neck shows cricoid fracture (arrow) anteriorly on the right side.

Etiology	Blunt trauma - for cricoid fracture and arytenoid dislocation Arytenoid dislocation - for left vocal cord paralysis
Incidence	Laryngeal fractures - < 1% of all blunt traumas Arytenoid dislocation - unknown, < 80% has been reported
Gender ratio	Laryngeal fractures - Common in males (77%) Arytenoid dislocation - No sex predilection
Age predilection	Laryngeal fractures - No sex predilection Arytenoid dislocation - No sex predilection
Risk factors	Laryngeal fractures - Females with long slender neck Arytenoid dislocation - laryngomalacia, acromegaly
Treatment	Vocal fold injections, Laryngeal framework surgery, Medialization laryngoplasty, Arytenopexy
Prognosis	Associated with 2% of mortality rate
Findings on imaging	Cricoid cartilage fracture, Left arytenoid dislocation, Laterally placed left vocal cord, Left aryepiglottic fold thickening, Widening of left ventricle

Table 1: Summary table for blunt injury of larynx with specific reference to arytenoid dislocation

	Conventional Radiograph	**CT**	**MRI**
Arytenoid Dislocation	Essentially normal	Cadaveric position of ipsilateral vocal cord, Displaced arytenoid, Ipsilateral aryepiglottic fold thickening, Widening of ipsilateral ventricle, Associated cricoid fracture	Cadaveric position of ipsilateral vocal cord, Ipsilateral aryepiglottic fold thickening, Widening of ipsilateral ventricle, Associated cricoid fracture
Nerve injury involving both recurrent laryngeal nerve and the external branch of the superior laryngeal nerve	Findings depend on the etiology, which is mostly iatrogenic surgical trauma.	Findings depend on the etiology, which is mostly iatrogenic surgical trauma. Normal arytenoid cartilages.	Findings depend on the etiology, which is mostly iatrogenic surgical trauma. Normal arytenoid cartilages.

Table 2: Differential table for arytenoid dislocation

ABBREVIATIONS

CT - Computed Tomography
ENT - Otorhinolaryngology
MRI - Magnetic Resonance Imaging
TE - Echo time
TR - Repetition time

KEYWORDS

Cricoid cartilage; arytenoid cartilage; vocal cord paralysis; thyroplasty

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