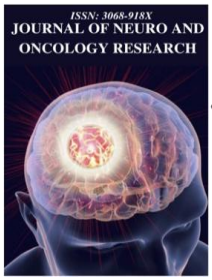

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Case Report

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Emergency Open Tracheostomy in Severe Ankylosing Spondylitis: Technical Adaptations and Comprehensive Review of the Literature: A Case Report

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Abstract

Background: Airway management in advanced Ankylosing Spondylitis (AS) is highly challenging in emergency critical care and anaesthesiology. Progressive spinal ossification causes rigid cervical deformities that limit alignment for direct or video laryngoscopy 1.2. In neurocritical emergencies, acute deterioration and reduced patient cooperation leave little margin for error.

Case Presentation: An older man with a 45-year history of untreated advanced AS presented with altered sensorium and a Glasgow Coma Scale score of 6. CT imaging revealed a massive right gangliocapsular haemorrhage with intraventricular extension, midline shift and mass effect. Airway assessment showed extreme fixed cervical flexion, making standard orotracheal intubation impossible. In the supine position, his head remained suspended approximately 1.5 feet above the operating table due to the deformity.

Intervention: Anticipating a "cannot intubate" scenario, the team performed an emergency open surgical tracheostomy under local anaesthesia with mild sedation while maintaining the patient's fixed position. Positioning was modified using pillow support to preserve cervical stability. A higher tracheal entry point below the cricoid cartilage was selected to avoid tube impingement against the sternum. A size 8 mm cuffed tracheostomy tube was successfully inserted within 12 minutes, improving oxygen saturation from 93% to 98%.

Conclusion: In patients with advanced AS and severe cervical deformity, early transition to a customised surgical tracheostomy may be lifesaving when translaryngeal intubation is not feasible. Prompt recognition of anatomical limitations and avoidance of cervical manipulation are critical for successful airway management.

Keywords: Ankylosing Spondylitis; Difficult Airway; Emergency Tracheostomy; Neurocritical Care; Open Surgical Airway

Introduction

Spondylitis refers to inflammation involving the vertebral column and may occur as part of a spectrum of inflammatory disorders collectively termed spondyloarthritis [1,2]. These disorders characteristically involve the axial skeleton, particularly the sacroiliac joints and spine and may be associated with enthesitis and varying degrees of peripheral joint involvement. Ankylosing Spondylitis (AS) is a chronic, progressive, seronegative inflammatory spondyloarthropathy predominantly affecting the axial skeleton [3,4].

Persistent inflammation in AS leads to structural damage followed by reactive new bone formation, progressive ossification of spinal ligaments and entheses and eventual ankylosis. In advanced disease, this process may produce the characteristic rigid "bamboo spine [6,7]. The prevalence of AS varies geographically, ranging from approximately 0.02% in sub-Saharan Africa to

0.35% in Northern Arctic populations [8]. The disease typically begins in the second or third decade of life and has historically been reported more frequently in males than females [9].

With disease progression, nearly 70% of patients develop cervical spine involvement after 20 years [10]. Advanced disease may result in syndesmophyte bridging and fixed cervical hyperkyphosis, producing the characteristic "chin-on-chest" deformity [11,12].

Advanced AS presents major airway management challenges. Cervical rigidity prevents achievement of the sniffing position required for direct laryngoscopy [2,13]. Temporomandibular joint involvement occurs in up to 35% of patients, causing restricted mouth opening and difficulty with insertion of laryngoscopes or supraglottic devices [14,15]. In addition, costovertebral and costotransverse ankylosis produces restrictive lung disease with reduced respiratory reserve and rapid desaturation during apnea [16,17].

Although awake fiberoptic bronchoscopy is considered the gold standard for elective difficult airway management, its utility is limited in emergencies [18,19]. In neurocritical patients with intracranial pathology, coma and pooling of secretions, rapid alternative airway strategies are often required [20,21]. We report a case of emergency open surgical tracheostomy in an unconscious neurocritical patient with advanced AS and severe fixed cervical flexion deformity.

Case Presentation

An elderly (70-year-old) male presented with acute altered sensorium for 5 hours before admission. On arrival, he was deeply comatose with drooling of saliva, stertorous breathing and pooling of oropharyngeal secretions. No history of trauma, falls or seizures was available. The patient had a 45-year history of untreated advanced ankylosing spondylitis with complete ossification of the axial skeleton. Comorbidities included type 2 diabetes mellitus, hypertension and severe coronary artery disease status post coronary artery bypass grafting.

Airway evaluation revealed severe fixed cervical flexion deformity with a rigid, non-extendable neck. The oral cavity and tracheal axis formed an extreme angulation, making airway alignment impossible. Standard airway indices could not be assessed reliably. In the supine position, severe cervicothoracic kyphosis caused the head and upper cervical spine to remain suspended nearly 1.5 feet above the operating table, preventing conventional positioning. Direct laryngoscopy was considered impossible. Awake fiberoptic intubation was contraindicated because of intracranial pathology, coma, lack of cooperation and high aspiration risk from pooled secretions. An anticipated "cannot intubate" scenario prompted the decision to perform emergency surgical tracheostomy before neurosurgical intervention.

Neurological examination showed a Glasgow Coma Scale (GCS) score of 6 (E1V1M4). The patient had no eye opening or verbal response and demonstrated flexion withdrawal of the right upper limb. Pupillary assessment was limited by bilateral corneal opacities. Vital parameters included blood pressure of 164/92 mmHg, pulse rate of 88/min, respiratory rate of 22/min and oxygen saturation of 93% on room air. Examination revealed marked rigidity of the vertebral column, trunk and major joints.

Emergency non-contrast CT brain showed a large acute right gangliocapsular haemorrhage with significant intraventricular extension. There was severe mass effect with compression of the right lateral ventricle and an 11 mm midline shift. In view of impending transtentorial herniation, emergency minicraniotomy and clot evacuation, alongwith insertion of an external ventricular drain was planned.

Airway management in a patient with the head suspended nearly 1.5 feet above the operating table due to a fixed cervical flexion deformity required major modifications to standard protocols. No attempt was made to forcibly extend the neck because manipulation of a fused ankylosing spondylitis spine may cause fractures, spinal cord injury or quadriplegia [22].

The space beneath the suspended head, neck and shoulders was supported using rigid pillows and towels to stabilise the patient in the natural flexed posture. An oropharyngeal airway was inserted and high-flow 100% oxygen was administered through a non-rebreather mask. The procedure was performed under local anaesthesia with cautious intravenous midazolam sedation while preserving spontaneous respiration. Continuous electrocardiography, blood pressure and pulse oximetry monitoring were

maintained.

After sterile preparation, the operative field was found to be severely restricted because the mandible approximated the sternum. Careful palpation identified the cricoid cartilage and upper tracheal rings.

Although standard tracheostomy is usually performed between the second and fourth tracheal rings, lower placement was not feasible in this patient because the tracheostomy tube would abut the sternum, risking displacement, kinking or posterior tracheal wall injury [23]. Therefore, a higher tracheal entry point immediately below the cricoid cartilage was selected.

A 1.5 cm transverse skin incision was made below the cricoid cartilage to minimise tissue dissection and bleeding within the anatomically restricted was carried out, the pretracheal fascia was divided and the thyroid isthmus was retracted inferiorly to expose the upper tracheal rings.

Despite the distorted anatomy, the trachea was identified and stabilised. A transverse incision was made through the intercartilaginous space below the first tracheal ring and the opening was gently dilated. A size 8.0 mm cuffed tracheostomy tube was inserted under direct vision, the cuff inflated and the tube connected to the mechanical ventilator circuit.

Respiration was confirmed on inspecting bilateral equal chest expansion and stable capnography waveforms. The procedure was completed in approximately 12 minutes. For compensating for prolonged hypoxia, an initial mechanical ventilation with FiO2 100% was done, oxygen saturation improved from 93% to 98%. The tracheostomy tube was secured with sutures and neck ties, haemostasis was confirmed and a sterile dressing was applied before transfer to the neurosurgical operating room (Fig. 1-4).

Figure 1: Clinical photograph of the patient in the supine position, demonstrating the severe fixed cervical flexion ("chin-on-chest") deformity secondary to long-standing, untreated ankylosing spondylitis. Note the significant anatomical angulation between the oral cavity and the trachea, which rendered conventional airway alignment impossible.

Figure 2: Clinical photograph taken during the emergency surgical tracheostomy, demonstrating the tracheostomy tube secured in situ. Due to the patient's fixed cervical kyphosis and resultant proximity of the mandible to the sternum, a high-entry surgical approach was utilised immediately inferior to the cricoid cartilage. This specific placement ensured airway security while preventing mechanical impingement of the tube against the manubrium sterni.

Figure 3: Lateral X-Ray of the Skull and Cervical Spine showing a 'bamboo-spine' appearance, classically seen in Ankylosing Spondylosis.

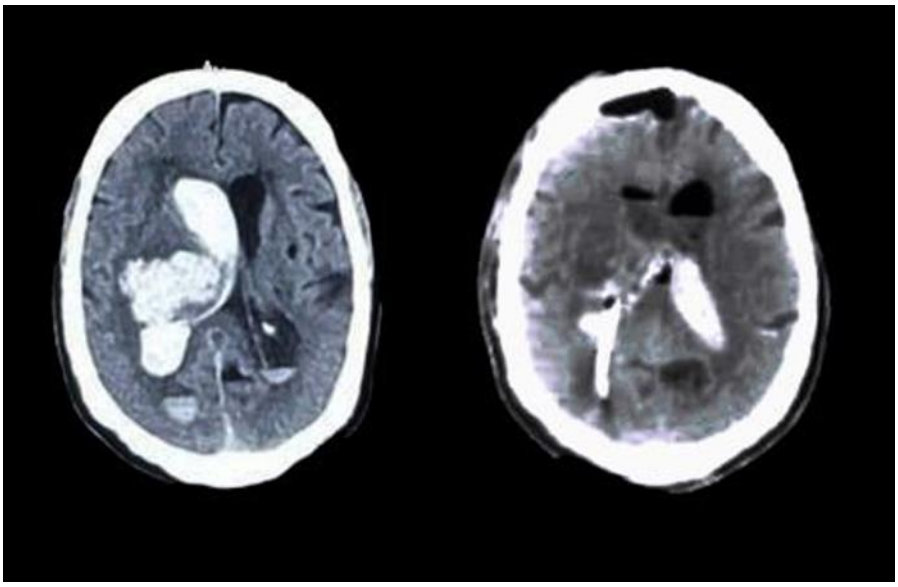

Figure 4: (left) Preoperative CT Brain showing a dense right gangliocapsular bleed with intraventricular haemorrhage. (right) Postoperative CT Brain showing a near total evacuation of the previously seen right Gangliocapsular bleed, with a ventricular drain in the right lateral ventricle.

Discussion and Literature Integration

Ankylosing Spondylitis (AS) presents a distinctive challenge to airway management because progressive inflammation, ossification and ankylosis of the axial skeleton may result in marked restriction of cervical spine movement and fixed cervicothoracic deformity. In advanced disease, cervical kyphosis, reduced atlanto-occipital extension, restricted mouth opening and an inability to assume the conventional supine or sniffing position can make direct laryngoscopy and tracheal intubation technically difficult or impossible. The ankylosed spine is also relatively susceptible to fracture and excessive manipulation of the cervical spine during airway manoeuvres may result in neurological injury. Consequently, airway management in severe AS requires preservation of the patient's pre-existing cervical alignment and minimisation of unnecessary spinal movement.

When difficulty is anticipated, awake tracheal intubation-particularly using flexible fibreoptic techniques has traditionally been favoured because it permits maintenance of spontaneous ventilation while limiting cervical manipulation. However, severe fixed deformity may occasionally render conventional oral or nasal intubation strategies impractical and deterioration of an already compromised airway may rapidly create a situation in which neither tracheal intubation nor effective oxygenation can be achieved. Current difficult-airway algorithms therefore emphasise early recognition of failure, limitation of repeated airway attempts, preservation of oxygenation and prompt progression to emergency Front-of-Neck Airway Access (eFONA) when a cannot-intubate, cannot-oxygenate situation occurs. Cricothyrotomy is generally the recommended emergency front-of-neck technique in such circumstances, while tracheostomy may constitute a definitive surgical airway when performed in an appropriately selected and controlled clinical setting.

Thus, in patients with advanced AS and extreme fixed cervical deformity, airway assessment must extend beyond predicting difficult laryngoscopy to anticipating the possibility that conventional airway access may fail altogether. Where anatomical distortion, positioning constraints and the urgency of definitive treatment substantially limit non-surgical airway options, early preparation for surgical airway access becomes an integral component of airway planning.

Pathophysiology of the Fused Cervical Airway

Chronic inflammation in AS causes progressive ossification of spinal ligaments and joints. Advanced disease demonstrates facet fusion in 20–50% of severe cases and bridging syndesmophytes in over 60% [25,26]. Progressive cervical rigidity and cervicothoracic kyphosis produce the characteristic “chin-on-chest” deformity, narrowing the oropharyngeal space and distorting normal airway landmarks.

Critique of Alternative Intubation Strategies

Awake Flexible Fiberoptic Intubation (AFI) is commonly preferred because it minimises cervical movement, but it requires a cooperative spontaneously breathing patient [27]. In this case, coma, pooled secretions, aspiration risk and urgent neurosurgical intervention made AFI impractical. Severe fixed flexion may also prevent passage of the bronchoscope.

Video laryngoscopy can improve glottic visualisation, but severe "chin-on-chest" deformity may prevent blade insertion and tube advancement because of distorted airway angulation [28]. Supraglottic airway devices may also fail because restricted mouth opening and fixed flexion limit insertion [29]. Blind nasotracheal intubation has been described as a rescue technique30, but carries risks of trauma, bleeding and oesophageal intubation [30].

Given these limitations, this scenario effectively represented an anticipated eFONA (emergency Front-of-Neck Access) situation, warranting immediate surgical airway access.

Open Surgical vs. Percutaneous Tracheostomy

Percutaneous Dilatational Tracheostomy (PDT) is widely used because of procedural speed, but it requires identifiable anatomical landmarks and neck extension [31,32]. Severe AS distorts cervical anatomy, increasing the risk of vascular injury, tracheal wall injury and procedural failure [33]. Therefore, open surgical tracheostomy is generally preferred in severe deformities because it allows direct visualisation and controlled dissection [34-38]. In this patient, the open approach enabled safe airway access despite markedly distorted anatomy.

Structural Interdependence: Spine Alignment and Airway Patency

pinal alignment directly influences airway access and long-term tracheostomy function in advanced AS [39,40]. Severe cervical flexion deformity narrows the anterior neck space and may contribute to airway obstruction and dysphagia. Previous reports have shown that correction of cervicothoracic alignment can improve airway patency and preserve swallowing and speech function41.

Perioperative Risk and Postoperative Complications

Patients with advanced AS remain at high perioperative risk. Airway oedema following cervical procedures may cause postoperative airway obstruction, failed decannulation and prolonged ICU stay [41-45]. Restrictive chest wall disease reduces pulmonary reserve and increases the risk of atelectasis, secretion retention and pulmonary infection [46,47]. Careful ventilatory support with appropriate PEEP is therefore essential [48].

Emerging Advanced Technologies

Advanced technologies may further improve airway management in severe deformities. Three-dimensional CT/MRI reconstruction can help predict difficult airways and define altered anatomy [49,50]. Bedside airway ultrasonography provides rapid real-time airway assessment with accuracy comparable to CT imaging [51-53]. Three-dimensional printing and augmented reality systems may also assist procedural planning and simulation in complex airway deformities [39,54,55-62].

Future Implications

This case highlights the importance of early recognition of patients in whom severe fixed spinal deformity may render conventional airway techniques difficult or unsafe. Future airway planning in advanced ankylosing spondylitis should emphasise multidisciplinary assessment, preservation of spontaneous ventilation where appropriate, availability of advanced airway devices and early preparedness for emergency front-of-neck or definitive surgical airway access. Simulation-based training and institutional difficult-airway protocols may further improve preparedness for these uncommon but potentially life-threatening scenarios.

Conclusion

Emergency airway management in advanced Ankylosing Spondylitis (AS) with fixed cervical deformity is highly challenging and may require alternatives to standard airway techniques. Severe cervicothoracic kyphosis can make conventional intubation unsafe or impossible.

This case shows that open surgical tracheostomy under local anaesthesia, with modified positioning and a higher tracheal entry point, can safely secure the airway despite severe anatomical restriction. Successful management of advanced AS requires multidisciplinary coordination between neurocritical care teams to ensure airway safety and to facilitate prompt definitive management.

Conflict of Interest

The authors declared no potential conflicts of interest with respect to the research, authorship and/or publication of this article.

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Data Availability Statement

The data supporting the findings of this study are available from the corresponding author upon reasonable request.

Informed Consent Statement

Written informed consent was obtained from the patient's legally authorised representative for the publication of this case report and any accompanying clinical details or images.

Authors' Contributions

All authors contributed equally to this paper.

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