Rheumatoid cervical joint disease - a challenge to the anaesthetist

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Cervical joint disease in rheumatoid arthritis patients is common. These patients may be at risk for severe life-threatening neurological problems in the perioperative period and thus present a challenge to the anaesthetist. By understanding the various anatomical abnormalities that may occur in rheumatoid cervical joint disease, the anaesthetist can design an appropriate management plan for the patient. The destruction of normal anatomy by rheumatoid arthritis can result in atlanto-axial subluxation (AAS) or subaxial subluxation. The atlanto-axial subluxation is further divided anatomically into anterior AAS, posterior AAS, vertical AAS, and lateral/rotatory AAS. In addition to the history and physical examination of the rheumatoid arthritis patient, radiological evaluation of the cervical spine is highly recommended. With the identification of the specific anatomical lesion the anaesthetist can predict and avoid movements which may lead to, or worsen, neurological problems. In the event of an emergency where full evaluation of the cervical spine is not possible the anaesthetist must presume that the rheumatoid patient has severe cervical spine instability and use the most cautious approach.

On rencontre souvent une atteinte de la colonne cervicale dans l'arthrite rhumatoïde. À la période périopératoire, ceux qui en souffrent présentent un risque élevé de complications neurologiques gravissimes et par le fait même un défi pour l'anesthésiste. C'est par la compréhension des anomalies anatomiques variées qui surviennent au cours de la maladie que l'anesthésiste peut développer un plan de conduite appropriée pour ces patients. La destruction de l'anatomie normale par l'arthrite rhumatoïde peut causer une subluxation de l'articulation atloïdo-

axoïdienne ou sous-axoïdienne. La subluxation atloïdienne se subdivise anatomiquement en antérieure, postérieure, verticale et latéro-rotatoire. En plus de l'histoire et l'examen physique de l'arthritique, une évaluation radiologique de la colonne cervicale est fortement recommandée. Grâce à l'identification des lésions anatomiques spécifiques, l'anesthésiste peut prévenir et éviter des mouvements susceptibles d'entraîner et d'aggraver les complications neurologiques. Dans l'éventualité d'une situation d'urgence ne permettant pas d'évaluation complète, l'anesthésiste doit toujours présumer que le patient rhumatoïde souffre d'une instabilité du rachis cervical grave et agir avec extrême prudence.

Patients with rheumatoid cervical joint disease (RCJD) may be at risk for severe life-threatening neurological problems in the perioperative period. The challenge to the anaesthetist is in understanding the various anatomical abnormalities of the rheumatoid cervical spine. This allows the anaesthetist to design an appropriate management approach to these patients.

Demographics

The prevalence of rheumatoid arthritis (RA) in the USA is estimated to be between 0.3–1.5%.¹ The disease is autoimmune in nature, and any of the body's synovial joints may be affected. Cervical joint involvement has been reported in different series to affect between 15–86% of patients with RA.^{2–5} Higher incidence of cervical joint involvement in RA patients occurs in those who are seropositive for rheumatoid factor, those with severe erosive disease of peripheral joints, and in patients on long-term steroid therapy.^{2,5,6} Whereas RA has a female to male predilection of 2–3:1, cervical joint involvement appears to be more common in males. Patients with juvenile RA do not appear to be at risk of developing RCJD.⁷

Anatomy

The normal organization of the cervical spine allows a high degree of mobility without damage to the contents of the neck. This complex integration of vertebral bodies, facet joints, synovial capsules and ligaments can be se-

Key words

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FIGURE 1 Types of atlanto-axial subluxation (AAS): (x = normal position of anatomical reference; x' = pathological position after subluxation; $\vdots$ = normal position of spinal cord). *Anterior AAS* – Lateral view of cranium and upper cervical spine. C_1 moves forward relative to C_2 due to transverse ligament destruction. (Dotted outline of C_1 and cranium represent their direction of movement with anterior AAS; $\vdots$ = forward traction of spinal cord by cranial contents with anterior AAS.)

verely disrupted by RA, leading initially to cervical spine subluxation which is followed occasionally by ankylosis of the cervical spine. The resulting cervical pathology has been divided into two main categories based on the anatomical abnormality: atlanto-axial subluxation (AAS) and subaxial subluxation. Atlanto-axial subluxation can be further defined by the particular direction that the atlas (C_1) subluxes in relation to the axis (C_2): anterior AAS, posterior AAS, vertical AAS, and lateral/rotatory AAS.⁶

Atlanto-axial subluxation

The C_1/C_2 vertebrae, interposing discs, ligaments and joints are the areas most commonly affected by RA of the cervical spine (15–35% of RA patients).³ Depending upon the particular supporting element which is destroyed, the atlas may sublux in relation to the axis in one of the four above-mentioned directions.

1 Anterior AAS – C_1 moves forward on C_2 due to trans-

FIGURE 2 *Posterior AAS* – Lateral view. C_1 moves posterior relative to C_2 due to odontoid process destruction. (Outline of C_1 represents the normal position; shaded C_1 and C_2 represent abnormal position.)

verse ligament destruction⁴⁻⁶ (Figure 1). This can result in compression of the cervical cord by the odontoid process. Anterior AAS compromises 80% of all AAS and is determined radiologically by examining the *flexion* view of lateral neck x-rays. Magnetic resonance imaging has also been reported to be useful in evaluating not only bony destruction and movement but actual neural compression.^{10,11} Subluxation is said to exist when the distance between the atlas and odontoid process in the lateral flexion view exceeds 3 mm in patients over 44 yr or exceeds 4 mm in younger patients.

2 Posterior AAS – C_1 moves backward on C_2 due to odontoid peg destruction (Figure 2). This is a rare form of AAS accounting for only 3–7% of patients. This lesion is best demonstrated on lateral *extension* x-rays of the neck.

3 Vertical AAS – Erosive joint diseases in the atlanto-occipital/atlando-axial joints leads to destruction of the lateral masses of C_1 .^{3,6,9} The odontoid process may then sublux upwards through the foramen magnum to compress the cervicomedullary junction (Figure 3). The

FIGURE 3 *Vertical AAS* - Lateral view. Destruction of lateral masses of C_1 allow upward subluxation of the odontoid process through the foramen magnum. (a = hard palate; b = tip of odontoid process; c = occipital curve)

prevalence of this type is 10–20% of all AAS and it may exist in combination with anterior AAS. Radiological evaluation of lateral skull and C-spine x-rays, and odontoid views through the mouth reveal that the tip of the odontoid process is superior to MacGregor's line (drawn from the upper surface of the posterior edge of the hard palate to the most caudal point on the occipital curve) by >8 mm in men and >9.5 mm in women.

- 4 *Lateral/Rotatory AAS* - Changes in the C_1C_2 facet joints lead to these uncommon deformities.⁶ They occur in approximately 2–5% of all patients with AAS. Lateral view tomograms of the occipitocervical junction and open mouth views of the odontoid are used to evaluate these deformities. The lateral or rotatory AAS deformities are characterized by C_1 moving laterally or rotationally with respect to C_2 (Figures 4 and 5); they may cause nonreducible rotational head tilt, spinal nerve compression, or vertebral artery compromise.

Subaxial subluxation

A less common deformity than those of the C_1C_2 region, subaxial subluxations (subluxations below C_2) occur in 10–20% of the RA population and appear to correlate with disease duration (as compared to AAS which do

FIGURE 4 *Lateral AAS* - Posterior view of cranium and upper cervical spine. C_1 and C_2 move laterally with respect to one another due to C_1C_2 facet destruction.

FIGURE 5 *Rotatory AAS* - X-sectional view of C_1 and C_2 . C_1C_2 facet destruction allows rotation of C_1 on C_2 with resulting compression of spinal nerve (N), vertebral artery (A), or spinal cord (S).

FIGURE 6 Subaxial subluxation: (x = normal position of anatomical reference; x' = pathological position after subluxation; I = normal position of spinal cord; outline of C_1 and C_2 represent their normal anatomical position; shaded drawings of C_1 and C_2 represent their position after subluxation). Destruction of facet joints below the level of C_2 allows antero-posterior subluxation of the vertebral bodies.

not correlate with disease duration).^{4,6} Compared with subluxation at the atlanto-axial level, subaxial subluxation with its pathological change of facet joint destruction can lead to earlier cervical column and spinal nerve compression because of the smaller diameter at these lower levels. The commonest level of involvement is C_5C_6 but more than one level may be involved. Lateral views of the cervical spine reveal a step deformity >2 mm (Figure 6).

While synovial joint destruction initially leads to subluxation, it is important to bear in mind that cervical spine ankylosis may develop as a final pathological state of rheumatoid arthritis. This ankylosis may result in a flexion deformity of the neck.^{12,13}

Evaluation and anaesthetic management

Patients with RCJD may present for surgical repair of their neck pathology, or for unrelated surgery. Those with poor neck mobility may present difficulty in visualization of the larynx. Other patients may be at risk of neuro-

logical and/or vascular damage resulting from cervical subluxation during laryngoscopy or neck positioning perioperatively. Deaths have been reported related to manipulation of the neck during the perioperative period in these patients.¹⁴⁻¹⁶ Consequently, in addition to the assessment of other medical problems of RA, it is important that the anaesthetist evaluate the cervical spine for RCJD.

Patients with RCJD may present with a puzzling array of symptoms and clinical findings. Disruption of the normal vertebral anatomy may cause vertebral artery compression, as well as compression of the cervical cord or spinal nerves. Patients may complain of occipital headaches (due to entrapment of the C_1C_2 roots); dysphagia, dysphonia, diplopia (due to cranial nerve compression with vertical AAS); persistent pain in the neck and arms (due to radicular entrapment at the subaxial level); involuntary movements of the extremities, attacks of dizziness and numbness in the upper extremities (due to long tract compression or vertebral artery insufficiency).

Physical assessment of these patients may be difficult due to the joint and muscle abnormalities associated with chronic RA. Long tract signs, spastic tetraparesis or paraparesis are suggestive of RCJD.

The usual preoperative physical examination with demonstration of neck flexion and atlanto-occipital extension to predict ease of laryngoscopy must be conducted gently, especially in those patients complaining of symptoms exacerbated by neck movement.^{12,17,18} Thorough assessment is required because both non-reducible and rotational subluxations and the later development of cervical ankylosis of RA may greatly interfere with neck mobility making laryngoscopy difficult.

Since cervical involvement in the adult form of RA is common (15–86%) and may be present in the absence of signs or symptoms,¹⁹ all adult patients with RA should undergo radiological evaluation before anaesthesia. On the basis of the resulting radiological findings a "lesion specific" approach can be developed to head and neck positioning both for laryngoscopy and for perioperative head positioning (Table). For some surgical procedures regional anaesthesia may be appropriate and may avoid the need for neck manipulation.

Atlanto-axial subluxation

1 Anterior atlanto-axial subluxation – Anterior AAS is worsened by C_1C_2 flexion. Extension of the C_1C_2 joint by direct laryngoscopy is therefore tolerated. The head should be maintained in a neutral to slightly extended position throughout the perioperative period.

2 Posterior atlanto-axial subluxation – This lesion is wor-

TABLE

<i>Rheumatoid C-spine abnormality</i>	<i>Potential problems for anaesthetist</i>	<i>Anaesthetist approach to C-spine</i>
<i>Atlanto-axial subluxation (AAS)</i>		
1 Anterior AAS	C ₁ C ₂ flexion may cause anterior spinal cord compression by odontoid process.	Avoid C ₁ C ₂ flexion during anaesthesia induction, surgical positioning or transport. Direct laryngoscopy is tolerated since C ₁ C ₂ is in extension.
2 Posterior AAS	C ₁ C ₂ extension may cause anterior spinal cord compression by atlas.	C ₁ C ₂ extension must be avoided. Direct laryngoscopy poses a significant risk – is best avoided.
3 Vertical AAS	Since the odontoid process protrudes through the foramen magnum, both flexion and extension may cause medullary compression.	Neutral head/neck positioning is mandatory throughout the perioperative period. Direct laryngoscopy should be avoided.
4 Lateral/rotatory AAS	Lateral shift or rotation of C ₁ C ₂ may compress vertebral arteries and/or spinal nerves. Severe lateral shift may lead to spinal cord compression.	Avoid any rotation or lateral movements of the head during the perioperative period. Nonreducible head tilt may preclude direct laryngoscopy.
<i>Subaxial subluxation</i>	Uncontrolled vigorous manipulation of the head and neck may cause spinal cord compression.	Direct laryngoscopy with neck stabilization in a neutral position should be tolerated.

sened by C₁C₂ extension. Therefore direct laryngoscopy is not recommended. (Refer to recommendations below for vertical AAS.) The head should be maintained in a neutral to slightly flexed position.

- 3 Vertical atlanto-axial subluxation – Vertical AAS is the most life-threatening of RCJD lesions due to the potential for cervical medullary compression. Throughout the perioperative period, the head and neck should always be maintained in a neutral position. Neutral positioning for the cervical spine can best be achieved utilizing the Philadelphia collar with bilateral sandbags joined by tape across the forehead. Soft collars, extrication collars, hard collars and Philadelphia collars alone are not sufficient to prevent flexion, extension, lateral or rotatory movements.²⁰ For airway control direct laryngoscopy, either awake or under anaesthesia, should be avoided. Safer techniques, which rely less on atlanto-axial extension, include awake fiberoptic tracheal intubation,²¹ awake blind nasal intubation,²² retrograde intubation,²³ or awake tracheostomy.

- 4 Lateral/rotatory atlanto-axial subluxation – These rare lesions will be exacerbated with rotational or lateral head movements and the anaesthetist must be careful in avoiding these directions of movement. The C₁C₂

extension during direct laryngoscopy is tolerated as long as the patient does not have problems with this movement preoperatively.

Subaxial subluxation

This collection of lesions is potentially exacerbated by extreme flexion and extension movements of the lower cervical spine. However, these lesions should not cause great problems since the lower cervical spine is straight at the time of direct laryngoscopy although the larynx is flexed.²⁴ Therefore, as with the recommendations for traumatic C-spine injuries which these lesions resemble, direct laryngoscopy with neutral neck stabilization should be tolerated.²⁵

Unlike patients with cervical joint subluxation, in whom movement of the head and neck may endanger neurological or vascular elements, the cervical joints of patients with late-stage cervical ankylosis may be fixed with resultant limitation of movement. This should be recognized and evaluated preoperatively in order to plan an appropriate approach to the airway.

In summary, when time allows the careful radiological evaluation of the C-spine, the anaesthetist can utilise a "lesion specific" approach to intubation and head positioning. The perioperative head position which is tolerated by all lesions is the neutral cervical spine. Direct laryn-

gосcopy should be avoided in cases of vertical or posterior AAS. Patients with other RCJD lesions should tolerate direct laryngосcopy.

In the urgent, life-threatening situation in which no time is available to evaluate the cervical spine radiologically before surgery, an approach to intubation must be developed which allows near total immobilization of the head and cervical spine. Since near maximal atlanto-axial extension is required for direct laryngосcopic visualization of the larynx,²⁴ the authors recommend avoidance of direct laryngосcopy in these patients. Use of one of the airway techniques previously recommended for vertical atlanto-axial subluxation management is suggested. The authors' preference is for awake flexible fiberoptic tracheal intubation.

Conclusion

Rheumatoid cervical joint disease is a common manifestation of adult rheumatoid arthritis. In the patient presenting for elective surgery preoperative radiological assessment of the neck is highly recommended. Direct laryngосcopy should be avoided in those RA patients with posterior or vertical atlanto-axial subluxation. In patients with other forms of AAS the trachea may be intubated with the help of direct laryngосcopy with appropriate neck stabilization.

In the case of urgent life-threatening problems where anaesthesia must be administered without complete evaluation of the cervical spine, the anesthetist should treat the rheumatoid patient as though he were at risk of life-threatening cervical spine instability and use the most cautious approach to airway management.

References

- 1 Zvaifler NJ. Etiology and pathogenesis of rheumatoid arthritis. In: McCarty DJ (Ed.). *Arthritis and Allied Conditions: A Textbook of Rheumatology* (11th ed.). Philadelphia, Lea & Febiger, 1989; 659.
- 2 Watt I, Cummins B. Management of rheumatoid neck. *Ann Rheum Dis* 1990; 49: 805-7.
- 3 Sherk HH. Atlanto/axial instability and acquired basilar invagination in rheumatoid arthritis. *Orthop Clin North Am* 1978; 9: 1053-63.
- 4 Smith PH, Benn RT, Sharp J. Natural history of rheumatoid cervical luxations. *Ann Rheum Dis* 1972; 31: 431-9.
- 5 Bland JH. Rheumatoid subluxation of the cervical spine (editorial). *J Rheumatol* 1990; 17: 134-7.
- 6 Santavirta S, Kankaanpää U, Sandelin J, Laasonen E, Kontinen YT, Slätis P. Evaluation of patients with rheumatoid cervical spine. *Scand J Rheumatol* 1987; 16: 9-16.
- 7 Hensinger RN, De Vito PD, Ragsdale CG. Changes in the cervical spine in juvenile rheumatoid arthritis. *J Bone Joint Surg (Am)* 1986; 68A: 189-98.
- 8 Marks JS. Rheumatoid neck. *Br J Hosp Med* 1985; 33: 96-100.
- 9 Hancock DO. The cervical spine in chronic rheumatoid arthritis. *Clin Rheum Dis* 1978; 4: 443-59.
- 10 Foley-Nolan D, Stack JP, Ryan M, et al. Magnetic resonance imaging in the assessment of rheumatoid arthritis - a comparison with plain film radiographs. *Br J Rheumatol* 1991; 30: 101-6.
- 11 Breedveld FC, Algra PR, Vielvoje CJ, Cats A. Magnetic resonance imaging in the evaluation of patients with rheumatoid arthritis and subluxations of the cervical spine. *Arthritis Rheum* 1987; 30: 624-9.
- 12 Edelist G. Principles of anesthetic management in rheumatoid arthritic patients. *Anesth Analg* 1964; 43: 227-31.
- 13 Eisele JH. Connective tissue diseases. In: Katz J, Benumof J, Kadis LB (Eds.). *Anesthesia and Uncommon Diseases*. Toronto: WB Saunders, 1981, 510-6.
- 14 Mikulowski P, Wollheim FA, Rotmil P, Olson I. Sudden death in rheumatoid arthritis with atlanto-axial dislocation. *Acta Med Scand* 1975; 198: 445-8.
- 15 Martel W, Page JW. Cervical vertebral erosions and subluxations in rheumatoid arthritis and ankylosing spondylitis. *Arthritis Rheum* 1960; 3: 546.
- 16 Munthe E. The cervical spine in rheumatoid arthritis (Editorial). *Scand J Rheum* 1987; 16: 7.
- 17 Moncur C, Williams HJ. Cervical spine management in patients with rheumatoid arthritis. *Phys Ther* 1988; 68: 509-15.
- 18 Santavirta S, Slätis P, Kankaanpää U, Sandelin J, Laasonen E. Treatment of the cervical spine in rheumatoid arthritis. *J Bone Joint Surg (Br)* 1988; 70: 658-67.
- 19 Pellicci PM, Ranawat CS, Tsairis P, Bryan WJ. A prospective study of the progression of rheumatoid arthritis of the cervical spine. *J Bone Joint Surg (Am)* 1981; 63A: 342-50.
- 20 Podolsky S, Baraff LJ, Simon RR, Hoffman JR, Larmon B, Ablon W. Efficacy of cervical spine immobilization methods. *J Trauma* 1983; 23: 461-5.
- 21 Patil VU, Stehling LC, Zauder HI. Fiberoptic endoscopy in anesthesia. Chicago: Year Book Medical Publishers, 1983; 78-87.
- 22 Gold MI, Buechel DR. A method of blind nasal intubation for the conscious patient. *Anesth Analg* 1960; 39: 257-63.
- 23 Barriot P, Riou B. Retrograde technique for tracheal intubation in trauma patients. *Crit Care Med* 1988; 16: 712-3.
- 24 Horton WA, Fahy L, Charters P. Disposition of cervical vertebrae, atlanto-axial joint, hyoid and mandible during x-ray laryngосcopy. *Br J Anaesth* 1989; 63: 435-8.
- 25 Hastings RH, Marks JD. Airway management for trauma patients with potential cervical spine injuries. *Anesth Analg* 1991; 73: 471-82.