Trachlight™ management of succinylcholine-induced subluxation of the temporomandibular joint: a case report and review of the literature

[Prise en charge avec le Trachlight™ d'une subluxation de l'articulation temporo-mandibulaire provoquée par la succinylcholine: présentation de cas et revue de la littérature]

Amanda Roze des Ordon MD,* Derek R. Townsend MD FRCPC*†

Purpose: We present a case of spontaneous subluxation of the temporomandibular joint (TMJ) induced by succinylcholine, to compare our experience with previous cases reported in the literature, and to review the pathophysiology, preoperative screening, and intraoperative management of TMJ instability.

Clinical features: A 39-yr-old female with primary hyperparathyroidism and a normal airway examination presented for elective parathyroidectomy. Following induction of anesthesia and the administration of succinylcholine prior to jaw manipulation, her mouth could not be opened, and we suspected spontaneous subluxation of the TMJ. We secured the airway with the use of a Trachlight™ and, subsequently, reduced the joint. Postoperatively, a history of mild TMJ-related symptoms was elicited.

Conclusion: Instability of the TMJ is not uncommon, and has several implications for airway management, highlighting the importance of preoperative screening. Limited mouth opening, due to spontaneous subluxation of the TMJ following succinylcholine-induced muscle relaxation in the absence of airway manipulation, has only twice been reported in the literature. This report highlights how tracheal intubation may be accomplished using the Trachlight™, in order to secure the airway prior to reduction of the subluxed joint.

Objectif : Nous présentons ici un cas de subluxation spontanée de l'articulation temporo-mandibulaire (ATM) provoquée suite à l'administration de succinylcholine, afin de comparer notre expérience à des cas rapportés précédemment dans la littérature, et de revoir la physiopathologie, le dépistage préopératoire et la prise en charge peropératoire de l'instabilité de l'ATM.

Éléments cliniques : Une femme de 39 ans souffrant d'hyperparathyroïdisme primaire mais dont l'examen des voies respiratoires n'avait rien révélé d'anormal a été admise pour une parathyroïdectomie programmée. Après l'induction de l'anesthésie et l'administration de succinylcholine avant de manipuler la mâchoire, la bouche n'a pas pu être ouverte, et nous avons soupçonné une subluxation spontanée de l'ATM. Nous avons intubé la patiente avec un dispositif Trachlight™ et, par la suite, réduit l'articulation. En période postopératoire, on a découvert des antécédents de symptômes bénins associés à une ATM.

Conclusion : L'instabilité de l'ATM est fréquente et a plusieurs conséquences sur la prise en charge des voies respiratoires, soulignant l'importance d'un dépistage préopératoire. Une ouverture limitée de la bouche en raison d'une subluxation spontanée de l'ATM après avoir provoqué une relaxation musculaire avec la succinylcholine et sans manipulation des voies respiratoires n'a été rapportée que deux fois dans la littérature. Cette présentation de cas met en exergue une façon de réaliser une intubation trachéale avec un Trachlight™, afin de sécuriser les voies aériennes, avant de réduire l'articulation subluxée.

CAN J ANESTH 2008 / 55: 9 / pp 616–621

From the Department of Anesthesiology and Pain Medicine,* and the Division of Critical Care Medicine,† University of Alberta Hospital, Edmonton, Alberta, Canada.

Address correspondence to: Dr. Derek R. Townsend, Intensivist and Anesthesiologist, Division of Critical Care Medicine, 3C1.12 8440 – 112 Street, University of Alberta Hospital, Edmonton, Alberta T6G 2B7, Canada. Phone: 780-407-8822; E-mail: drt1@ualberta.ca

Disclosures: None.

Accepted for publication May 16, 2008.

Revision accepted June 18, 2008.

TEMPOROMANDIBULAR joint (TMJ) instability, while not always symptomatic, has a prevalence of up to 25–50% in the general population, and is most common in middle-aged females.^{1,2} Such instability may have important implications for airway management during anesthesia. The following report describes a patient who developed succinylcholine-induced subluxation of the TMJ, resulting in a fixed obstruction to mouth opening prior to airway manipulation. We discuss our approach to airway management, as compared to strategies previously reported in the literature, followed by a review of the pathophysiology, preoperative screening, and intraoperative management of TMJ instability. We obtained consent for publication of the case report from the patient.

Clinical report

A 39-yr-old, 75 kg, 165 cm female with a history of primary hyperparathyroidism presented for a left inferior parathyroidectomy. Her preoperative assessment revealed a further history of gastroesophageal reflux, and examination of her airway was unremarkable, with a Mallampati I score, an interincisor gap > 4 cm, a thyromental distance > 6 cm, and good neck mobility. The baseline serum parathyroid hormone level was elevated at 16 pmol·L⁻¹ (normal range 1.1–6.8) with hypercalcemia (serum Ca 2.87 mmol·L⁻¹; normal range 2.10–2.60) and normal serum albumin (46 g·L⁻¹; normal range 35–50); a parathyroid scan documented a left inferior parathyroid adenoma.

The patient was preoxygenated in the operating room, and general anesthesia was induced with fentanyl 200 µg (2.6 µg·kg⁻¹), lidocaine 60 mg (0.8 mg·kg⁻¹), propofol 150 mg (2 mg·kg⁻¹), and succinylcholine 100 mg (1.3 mg·kg⁻¹) while cricoid pressure was applied. However, upon attempting direct laryngoscopy, the patient's mouth could not be opened by more than 1 cm, which was insufficient to accommodate a laryngoscope. There was no evidence of increased tone in the masseter muscles. In spite of bag-mask ventilation with continued cricoid pressure, and initiating sevoflurane, her mouth opening did not improve, and the possibility of TMJ displacement was suggested. Alternative techniques for intubation were considered, and it was decided to use a TrachlightTM. Following additional bag-mask ventilation, the airway was easily secured using the TrachlightTM to insert a 7 mm endotracheal tube. The otorhinolaryngology surgeon examined the airway post-intubation, and confirmed that the TMJ was subluxed. The joint was easily reduced, and surgery proceeded uneventfully. The patient's trachea was extubated following the pro-

FIGURE The temporomandibular joint (TMJ). A) Normal TMJ position with the mouth closed. B) Normal TMJ position with mouth opening. C) Abnormal anterior subluxation of the TMJ articular disc with mouth opening.

cedure, as soon as she was breathing spontaneously and able to follow commands.

Postoperatively, the patient was informed of the intraoperative events, and was advised to report her TMJ instability should she require surgery in the future. When questioned further, she described intermittent jaw clicking over the past two years with no associated pain or subluxation and no history of facial trauma or jaw subluxation during a previous intubation. Follow-up several weeks later revealed that she had been experiencing right-sided jaw pain since the surgery and had visited her dentist for further evaluation.

Discussion

The above report is a case of spontaneous subluxation of the TMJ following succinylcholine-induced muscle relaxation. As the initial anesthetic plan had been for a rapid sequence induction, the airway had not been manipulated prior to attempting direct laryngoscopy; thus, it was the administration of a rapidly effective neuromuscular blocker and resultant loss of tone in the surrounding muscles which allowed subluxation of a previously unrecognized unstable joint.

The TMJ is a synovial joint consisting of an articular disc interposed between the condylar process of the mandible and the glenoid fossa of the temporal bone and supported by surrounding muscles and ligaments (Figure 1A). Normal mouth opening involves rotation

of the condyle to achieve an initial 20 mm of opening, followed by anterior translation of the condyle and articular disc within the glenoid fossa to achieve a further 25 mm of opening (Figure 1B). Anterior displacement of the *disc* results in a fixed resistance to mouth opening (Figure 1C) producing a closed lock; whereas anterior displacement of the *mandibular condyle* over the disc results in obstruction to closing, so that the TMJ is locked open.³ The TMJ is unique in that it can become subluxed without external force,⁴ although external force, including jaw thrust and laryngoscopy, will facilitate the process. Dysfunction of the TMJ can result from damage to the articular process, itself or from loss of articular support from surrounding muscles or ligaments, as occurs under general anesthesia, particularly with the use of a neuromuscular blocking drug. Predisposing pathological processes include trauma, inflammation, infection, and infiltration, as well as muscle spasm and ligamentous laxity.³

A search of the literature revealed numerous reports of TMJ displacement during anesthesia (Table I); yet the majority of cases have occurred following manipulation of the airway, either in conjunction with succinylcholine, a non-depolarizing neuromuscular blocking agent, or in association with general anesthesia without neuromuscular blockade. The mouth was fixed open in six of these cases, allowing easy intubation and postoperative reduction; whereas the mouth was fixed closed in the other 13 reports, imposing a challenge for airway management. Spontaneous subluxation of the TMJ, with closed locking of the joint following succinylcholine-induced muscle relaxation in the absence of airway manipulation, has only twice been described in the literature, both occurrences in female patients with a normal airway examination. The first case report involved a patient in early pregnancy undergoing an exploratory laparotomy. Her mouth opening was limited after a bolus of succinylcholine, and attempts at blind intubation were unsuccessful.⁵ The second case report involved an impaired mouth opening after the administration of succinylcholine. Retrospective review of an old anesthetic record revealed a similar episode which had been misdiagnosed as masseter muscle rigidity.⁶ In both reports, the patient's lungs had been ventilated with a bag and mask; both patients were then awakened and their surgery was rescheduled. In both cases, the subluxation, which reoccurred with subsequent induction of anesthesia, was recognized, and the patient's jaws were reduced prior to tracheal intubation. Based on our experience, an alternative approach to the patient with spontaneous TMJ subluxation and limited mouth

opening following induction of anesthesia is to secure the airway with the use of a TrachlightTM and to perform reduction, post-intubation.

In a number of the previous case reports involving TMJ displacement during induction of anesthesia (Table I), the patient had symptoms referable to the TMJ which were only recognized retrospectively during the postoperative period; whereas other patients had previously been asymptomatic. Certainly, although not always possible, identifying the presence of TMJ dysfunction prior to induction would be advantageous in allowing for appropriate planning of airway management. An observational study by Agro *et al.*⁶ screened 68 patients for TMJ dysfunction; nine of the patients were found to have been symptomatic prior to tracheal intubation. After tracheal intubation, four of the nine patients experienced a worsening of symptoms; whereas three of the previously asymptomatic patients developed symptoms of TMJ dysfunction. This study highlights the importance of gentle laryngoscopy, in order to prevent TMJ-related symptoms, and it demonstrates that screening can effectively identify TMJ dysfunction in patients who may not otherwise report their symptoms. Screening for TMJ disorders can easily be performed as a component of the preoperative assessment (Table II).^{3,6} Should initial questioning generate a positive response or physical examination reveal findings suggestive of TMJ instability, further history, evaluation, and preparation should be undertaken to ensure that the airway can safely be secured and complications avoided. For example, a history of jaw clicking suggests displacement of the articular disc with spontaneous reduction.³ For patients with such a history, it has been suggested that a 25-mm soft bite block be inserted prior to induction, in order to splint open the jaw to the point where reduction has occurred, thereby preventing the joint from becoming locked.⁷

Should TMJ subluxation with limited mouth opening occur during induction of anesthesia, tracheal intubation can be accomplished with the use of a TrachlightTM, as in our experience, or with a fiberoptic bronchoscope.⁸ Alternatively, the joint can be reduced prior to intubation. With closed locking, secondary to anterior displacement of the articular *disc*, reduction can be accomplished by placing the thumbs over the buccal aspect of the mandibular ridge and applying downward and forward pressure.⁹ Conversely, to reduce an anteriorly displaced *mandible* with open locking of the TMJ, the pressure should be applied in a downward and backward direction.¹⁰ To prevent morbidity related to the development of fibrosis and adhesions within the joint capsule, early recognition and

TABLE I Summary of case reports of TMJ displacement during anesthesia

<i>Case report</i>	<i>History of TMJ symptoms*</i>	<i>Neuromuscular blockade</i>	<i>Airway manipulation prior to TMJ displacement</i>	<i>Mouth position</i>	<i>Management</i>
Rastogi ¹⁰ 1997	Yes	Succinylcholine	Yes (trachlight)	Locked open post-intubation	TMJ reduced postoperatively
Yemen ¹³ 1993**	Not mentioned	1. Succinylcholine 2. Atracurium	1. No 2. Yes (BMV)	1. Locked closed pre-intubation 2. Locked closed pre-intubation	1. Unable to intubate; awakened patient 2. TMJ reduced prior to intubation
Gambling ¹⁴ 1988	Yes	Succinylcholine	No	Locked open pre-intubation	TMJ reduced postoperatively
Sosis ⁴ 1987	Yes	Succinylcholine	Yes (NG placement)	Locked open post-intubation	TMJ reduced intraoperatively
Redick ⁵ 1987**	Not mentioned	1. Succinylcholine 2. Succinylcholine	No	1. Locked closed pre-intubation 2. Locked closed pre-intubation	1. Unable to intubate; awakened patient 2. TMJ reduced prior to intubation
Rattan ¹¹ 2006	Not mentioned	Not specified	Yes (laryngoscopy)	Locked open post-intubation	Delayed TMJ reduction (3 mo)
Tey ¹⁵ 1986	Yes	Not specified	No	Locked closed pre-intubation	TMJ reduced prior to intubation
Small ⁷ 2004	Yes	Rocuronium	Yes (BMV)	Locked closed pre-intubation	TMJ reduced prior to intubation
Iguchi ¹⁶ 2004	Not mentioned	Vecuronium	Yes	Locked closed pre-intubation	Standard laryngoscopy
Lim ¹⁷ 2001	Yes	Vecuronium	Yes (BMV)	Locked closed pre-intubation	TMJ reduced postoperatively ILMA intubation
Liu ⁹ 2001	Rheumatoid arthritis	Vecuronium	Yes (BMV)	Locked closed	TMJ reduced prior to intubation
Rastogi ¹⁰ 1997	Yes	Pancuronium	Yes (OGT placement)	Locked open post-intubation (awake FOI)	TMJ reduced postoperatively
Gould ¹² 1995	No	Vecuronium	Yes (laryngoscopy)	Locked closed post-intubation	Delayed TMJ imaging (5 mo)
Gould ¹² 1995	No	Atracurium	Yes (laryngoscopy)	Locked closed post-intubation	Delayed TMJ imaging (10 mo)
Awsare ¹ 2006	Not mentioned	None	Yes (jaw thrust)	Locked open pre-intubation	TMJ reduced prior to LMA insertion
Ting ¹⁸ 2006	Not mentioned	None	Yes (jaw thrust)	Locked open post-LMA insertion	TMJ reduced postoperatively
Patane ⁸ 1988	No	None	No	Locked closed pre-intubation	Asleep nasal fiberoptic intubation
Patel ¹⁹ 1979	Not mentioned	None	No	Locked semi-closed	TMJ reduced prior to intubation
Bellman ²⁰ 1978	Not mentioned	None	Not specified	Locked semi-closed	BMV for case TMJ reduced postoperatively

*Identified retrospectively in the postoperative period. **Numbers 1 and 2 refer to the same patient on separate occasions. BMV = bag mask ventilation; NG = nasogastric tube; ILMA = intubating laryngeal mask airway; OGT = orogastric tube; FOI = fiberoptic intubation.

TABLE II Screening assessment for TMJ dysfunction^{3,20}

History
– TMJ or pre-auricular pain
– restricted or excessive TMJ mobility
– clicking or grating with mouth opening
– previous maxillofacial trauma
Physical
– limited mouth opening
– inability to prognath
– deviation of the mandible with movement
– TMJ tenderness with movement
– TMJ crepitus with movement

TMJ = temporomandibular joint.

reduction of a displaced TMJ are important. Unrecognized TMJ displacement following tracheal intubation has previously been reported, with the affected patients experiencing chronic pain and restricted joint mobility.^{11,12} Manual reduction was not possible, and, in one case, surgical correction was required.¹¹ Such complications may be avoided by ensuring integrity of the TMJ complex, post-extubation.

Finally, it is interesting to consider why only certain patients with TMJ dysfunction develop subluxation during induction of anesthesia, and it would be relevant to determine whether the articular disc or the mandible becomes anteriorly displaced during subluxation (producing a closed lock *vs* open lock, respectively). Is the insertion of a soft bite block an effective method for preventing closed locking of the TMJ, and if so, would such a practice, prior to induction of anesthesia, be warranted in all patients at risk for subluxation, considering the prevalence of TMJ dysfunction and the risks associated with difficult intubation? These unresolved questions warrant further investigation into the optimal perioperative management of patients with TMJ dysfunction.

In summary, we report a case of succinylcholine-induced TMJ subluxation, with closed locking of the mouth, imposing a challenge for tracheal intubation. The airway was effectively secured with a TrachlightTM, followed by manual reduction of the TMJ. As the prevalence of TMJ dysfunction in the general population is considerable, routine preoperative screening for this disorder would enable the identification of patients at increased risk for TMJ displacement during induction of anesthesia and, accordingly, facilitate the planning of airway management. As the prompt reduction of a displaced TMJ is important for prevention of joint fibrosis and chronic disability, post-extubation assessment of TMJ function is crucial for avoiding iatrogenic-related morbidity.

References

- 1 *Awsare AN, Prakash N.* Temporomandibular dislocation: should every doctor be trained in resetting the jaw? *Br J Oral Maxillofac Surg* 2006; 44: 339.
- 2 *LeResche L.* Epidemiology of temporomandibular disorders: implications for the investigation of etiologic factors. *Crit Rev Oral Biol Med* 1997; 8: 291–305.
- 3 *Aiello G, Metcalf I.* Anaesthetic implications of temporomandibular joint disease. *Can J Anaesth* 1992; 39: 610–6.
- 4 *Sosis M, Lazar S.* Jaw dislocation during general anaesthesia. *Can J Anaesth* 1987; 34: 407–8.
- 5 *Redick LF.* The temporomandibular joint and tracheal intubation. *Anesth Analg* 1987; 66: 675–6.
- 6 *Agro F, Salvinelli F, Casale M, Antonelli S.* Temporomandibular joint assessment in anaesthetic practice. *Br J Anaesth* 2003; 90: 707–8.
- 7 *Small RH, Ganzberg SI, Schuster AW.* Unsuspected temporomandibular joint pathology leading to a difficult endotracheal intubation. *Anesth Analg* 2004; 99: 383–5.
- 8 *Patane PS, Ragno JR Jr, Mahla ME.* Temporomandibular joint disease and difficult tracheal intubation. *Anesth Analg* 1988; 67: 482–3.
- 9 *Liu YH, Wang JJ, Chang CF, Jin CH.* Difficult tracheal intubation as a result of unsuspected abnormality of the temporomandibular joint. *Anesth Analg* 2001; 92: 783–4.
- 10 *Rastogi NK, Vakharia N, Hung OR.* Perioperative anterior dislocation of the temporomandibular joint. *Anesth Analg* 1997; 84: 924–6.
- 11 *Rattan V, Arora S.* Prolonged temporomandibular joint dislocation in an unconscious patient after airway manipulation. *Anesth Analg* 2006; 102: 1294.
- 12 *Gould DB, Banes CH.* Iatrogenic disruptions of right temporomandibular joints during orotracheal intubation causing permanent closed lock of the jaw. *Anesth Analg* 1995; 81: 191–4.
- 13 *Yemen TA.* Are we obsessed with masseter muscle rigidity? Temporomandibular joint disease mistakenly diagnosed as masseter muscle rigidity on two separate occasions in one patient. *Anesth Analg* 1993; 77: 848–50.
- 14 *Gambling DR, Ross PL.* Temporomandibular joint subluxation on induction of anesthesia. *Anesth Analg* 1988; 67: 91–2.
- 15 *Tey HK.* Difficult tracheal intubation as a result of unsuspected abnormality of the temporomandibular joint. *Anaesthesia* 1986; 41: 436–7.
- 16 *Iguchi N, Fukumitsu K, Kinouchi K, Kawaraguchi Y, Yamanishi T.* Lockjaw caused by induction of anesthesia in a volunteer bone marrow donor (Japanese). *Masui* 2004; 53: 306–8.

- 17 *Lim BS, Andrews R.* Unexpected difficult intubation in a patient with normal airway on assessment. *Anaesth Intensive Care* 2001; 29: 642–3.
- 18 *Ting J.* Temporomandibular joint dislocation after use of a laryngeal mask airway. *Anaesthesia* 2006; 61: 201.
- 19 *Patel A.* Jaw dislocation during anaesthesia. *Anaesthesia* 1979; 34: 376.
- 20 *Bellman MH, Babu KV.* Jaw dislocation during anaesthesia. *Anaesthesia* 1978; 33: 844.

Sacre Coeur from the Eiffel Tower – Paris