Journal of Clinical Neuroscience 25 (2016) 75–78

Contents lists available at ScienceDirect

Journal of Clinical Neuroscience

journal homepage: www.elsevier.com/locate/jocn

Clinical Study

The role and safety of the sitting position in instrumented cervical surgery

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ARTICLE INFO

Article history:
Received 8 February 2015
Accepted 3 May 2015

Keywords:
Air embolism
Cervical vertebrae
Instrumentation
Neurosurgery
Spine

ABSTRACT

Placing patients who are undergoing neurosurgical procedures to the cervical spine in the sitting position offers significant advantages. These must be counterbalanced against the risk of venous and paradoxical air embolism. This study addresses the role and safety of the sitting position for instrumented cervical surgery. Twenty-five consecutive patients who underwent instrumented cervical surgery in the sitting position were recruited via retrospective analysis. Complications arising from the surgical procedure – specifically venous air embolism – were recorded, as well as pre- and post-operative haemoglobin levels. The incidence of venous air embolism was 0% (97.5% one-sided confidence interval: 0–13.7%). However, five other complications occurred (incidence rate of 20% with a 95% confidence interval of 6.8–40.7%). With appropriate precautions, screening and specific indications, the sitting position can be safely used in more complex instrumented cervical surgery.

1. Introduction

The positioning of patients for cervical spine surgery is critical for assuring the success of an operation [1]. Major considerations in this regard include access, exposure, alignment, stability, venous congestion, haemorrhage and haemostasis. The majority of cervical spine operations are performed with the patient in the prone position [2–5] (Fig. 1). The use of the sitting position offers advantages, including decreased venous pressure, optimum midline access, lowered intracranial pressure (ICP) and a relatively dry surgical field [6] (Fig. 2). These advantages have particular benefit for certain patient groups whose wellbeing may be compromised in the prone position. To our knowledge, these benefits have been largely neglected by the literature due to concerns about venous air embolism (VAE).

Patient groups potentially benefitting from this position are summarised in Table 1. Patients requiring front/back cervical surgery can have their operative time substantially reduced and safety improved in the sitting position. Enhanced control of an unstable spine can be achieved in the sitting position, particularly for morbidly obese patients and patients with ankylosing spondylosis. The sitting position also allows radiological visualisation of the cervical spine for purposes of instrumentation, usually obscured by the shoulders in the prone position. Furthermore, optimal cervical spine positioning – extremely important for patients undergoing occipitocervical fusion – is far more easily assessed and facilitated in a sitting position. The sitting position is also a viable alternative for patients where the prone or lateral positions are contraindicated. In addition to being difficult to position, morbidly obese patients may develop venous congestion in the prone position making haemostasis and visualisation of the operative site problematic. The prone position may also cause unacceptably raised ICP in patients with intracranial hypertension, potentially precluding head injured patients with cerebral swelling from undergoing essential surgical stabilisation or decompression procedures, compromising nursing care.

The advantages of the sitting position are counterbalanced by the risk of venous and paradoxical air embolism. VAE requires a breach of the venous circulation and a pressure gradient favouring air entry. Risk is increased in the sitting position due to gravity causing negative venous pressures at the surgical site [7]. The incidence of this complication has been documented as to be between 7% and 76% in previous series (Table 2) [4,8–18]. The wide variation in the incidence of VAE may be attributed to the differences in sensitivities and specificities of the detection techniques deployed [7]. Furthermore, published studies using sensitive monitoring techniques may often describe clinically insignificant VAE [19]. A paradoxical air embolism occurs when a VAE enters the arterial circulation via an arteriovenous shunt such as a patent foramen ovale.

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http://dx.doi.org/10.1016/j.jocn.2015.05.049
0967-5868/

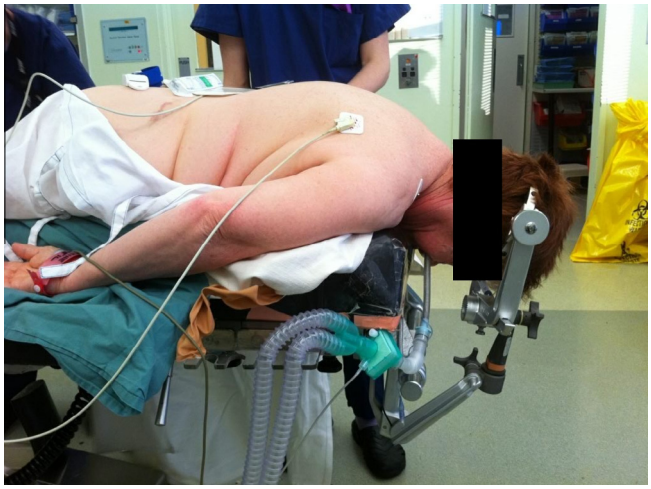

Fig. 1. Photograph of a patient placed in the prone position for cervical spine surgery. Note the level of the operative site situated below the level of the heart despite the head of the bed being elevated. (This figure is available in colour at http://www.sciencedirect.com/.)

Table 1
Indications that may suggest the use of the sitting position

Front/back cervical procedures
Spinal cord compression
Raised intracranial pressure
Morbid obesity
Unstable spine due to fracture or ankylosing spondylosis
Surgical preference

In 2006 Leslie et al. reported on the use and safety of the sitting position for cervical, craniocervical junction and cranial surgery in the sitting position for 100 consecutive patients by a single surgeon at the Royal Melbourne Hospital, Australia. No significant sequelae were described [7]. This experience and the advantages described above motivated our extending the use of the sitting position to more complex cervical spine surgery, particularly surgery requiring instrumentation, which to our knowledge has hitherto gone unreported.

2. Method

Twenty-five consecutive patients who underwent instrumented cervical surgery in the sitting position were retrospectively analysed from medical records. All patients were operated on by the same surgeon between August 2004 and October 2010. The study was approved by the Office for Research at Melbourne Health.

Fig. 2. Photograph of a patient placed in the sitting position for cervical spine surgery. The head is fixed using a Mayfield head clamp (Integra, Plainsboro, NJ, USA) attached to a bridge secured to the operating table situated at the level of the patient's knees. (This figure is available in colour at http://www.sciencedirect.com/.)

Patient demographics, length of surgery, pre- and post-operative haemoglobin (Hb) and complications arising from the surgical procedure were documented. VAE was defined as a decrease in end tidal carbon dioxide ($ETCO_2$) of $\geqslant$5 mmHg within 5 minutes. Hypotension was defined as a reduction in systolic blood pressure of $\geqslant$25% from the baseline systolic blood pressure. Other complications were noted when they occurred.

3. Results

Patient characteristics are summarised in Table 3. The mean pre-operative Hb was 127.6 g/L (standard deviation of 19.1 g/L), while mean post-operative Hb was 108.3 g/L (standard deviation of 16.2 g/L) (Table 4). The incidence rate of VAE in instrumented cervical surgery in the sitting position was 0% (97.5% one-sided confidence interval: 0–13.7%). However, five other complications occurred (incidence rate of 20% with a 95% confidence interval of 6.8–40.7%). These complications were the dehiscence of the posterior wound of a front/back procedure requiring return to theatre for rostral extension of the instrumentation, a misplaced lateral mass screw, post-operative meningitis and a cervical cord contusion with transient hemiparesis caused by sublaminar wires.

4. Discussion

The sitting position has acquired a reputation, particularly in anaesthetic circles, of having an unacceptable risk of associated

Table 2
Incidence of venous air embolism during neurosurgical procedures conducted with the patient in the sitting position

Authors	Year	Type of study	Patients, n	Incidence (%)	Method of detection
Bithal et al. [8]	2004	Prospective	334	28	Capnography
Harrison et al. [9]	2002	Retrospective	407	9.3	Capnography
Duke et al. [10]	1998	Retrospective	222	28	Capnography, Doppler, TOE
Papadopoulos et al. [11]	1994	Prospective	62	76	TOE
Black et al. [4]	1988	Retrospective	333	45	Doppler
Young et al. [12]	1986	Retrospective	255	30	Doppler
Matjasko et al. [13]	1985	Retrospective and prospective	554	23.5	Doppler
Standefer et al. [14]	1984	Retrospective	488	7	Doppler
Voorhies et al. [15]	1983	Prospective	81	50	Doppler
Albin et al. [16]	1978	Retrospective	400	25	Doppler
Albin et al. [17]	1976	Retrospective	180	25	Doppler
Michenfelder et al. [18]	1972	Prospective	69	32	Doppler

TOE = transoesophageal echocardiography.