The Journal of Emergency Medicine, Vol. 50, No. 3, pp. 427–432, 2016

0736-4679/$ - see front matter

ELSEVIER

http://dx.doi.org/10.1016/j.jemermed.2015.09.009

Brief Reports

THE EFFECT OF CRICOID PRESSURE ON THE UNSTABLE CERVICAL SPINE

Mark L. Prasarn, MD,* MaryBeth Horodyski, EDD, ATC,† Prism Schneider, MD, PHD,* Adam Wendling, MD,‡ Carin A. Hagberg, MD,§ and Glenn R. Rechtine, MD||

*Department of Orthopaedic Surgery, University of Texas, Houston, Texas, †Department of Orthopaedic Surgery, University of Florida, Gainesville, Florida, ‡Department of Anesthesiology, University of Florida, Gainesville, Florida, §Department of Anesthesiology, University of Texas, Houston, Texas, and ||Department of Orthopaedic Surgery, Veterans Affairs Hospital, Asheville, North Carolina

Reprint Address: Mark L. Prasarn, MD, Department of Orthopaedic Surgery, University of Texas, 6400 Fannin Suite 1700, Houston, TX 77030

☐ **Abstract—Background: It has been proposed that cricoid pressure can exacerbate an unstable cervical injury and lead to neurologic deterioration. Objective: We sought to examine the amount of motion cricoid pressure could cause at an unstable subaxial cervical spine injury, and whether posterior manual support is of any benefit. Methods: Five fresh, whole cadavers had complete segmental instability at C5–C6 surgically created by a fellowship-trained spine surgeon. Cricoid pressure was applied to the anterior cricoid by an attending anesthesiologist. In addition, the effect of posterior cervical support was tested during the trials. The amount of angular and linear motion between C5 and C6 was measured using a Fastrak, three-dimensional, electromagnetic motion analysis device (Polhemus Inc., Colchester, VT). Results: When cricoid pressure is applied, the largest angular motion was 3 degrees and occurred in flexion-extension at C5–C6. The largest linear displacement was 1.36 mm and was in anterior-posterior displacement of C5–C6. When manual posterior cervical support was applied, the flexion-extension was improved to less than half this value (1.43 degrees), and this reached statistical significance ($p = 0.001$). No other differences were observed to be significant in the other planes of motion with the applications of support. Conclusions: Based on the evidence presented, we believe that the application of cricoid pressure to a patient with a globally unstable subaxial cervical spine injury causes small displacements. There may be some benefit to the use of manual posterior cervical spine support for reducing motion at such an injured segment.** © 2016 Elsevier Inc.

☐ **Keywords—cricoid pressure; airway; aspiration; cervical spine; injury**

INTRODUCTION

Optimal management of the airway in trauma victims with cervical spine injuries has been debated. Crosby published a review concluding that a variety of airway-management strategies are safe and acceptable (1). In addition, manual in-line stabilization with application of cricoid pressure was recommended to reduce the risk of aspiration by preventing both gastric insufflation during bag-valve-mask ventilation and passive regurgitation of gastric contents (1). Despite this, there is concern that cricoid pressure can exacerbate an unstable cervical spine injury and lead to permanent neurologic injury or "harmful conversion" (2–4). Even though this is a major concern for medical professionals involved with airway management of trauma patients, it is also expected that all measures to prevent aspiration will be taken if the need arises. Aspiration in any patient can result in devastating medical morbidity and possibly mortality. Previous studies of cervical spine movement with application of cricoid pressure in cadaveric models have been radiographic and based solely on anterior-posterior displacement or flexion-extension angulation; essentially examining only one plane of motion and

RECEIVED: 9 June 2015; FINAL SUBMISSION RECEIVED: 28 August 2015;
ACCEPTED: 4 September 2015

performing the investigation in cadavers with uninjured cervical spines (5).

In this prospective observational study, we sought to investigate the effect of cricoid pressure on cervical spine motion at an unstable subaxial injury in a cadaver model and using an electromagnetic motion analysis device measuring motion in all three dimensions. In addition, we wished to examine whether or not manual posterior cervical spine support might be beneficial in reducing motion at the injured segment while applying cricoid pressure. Our hypothesis was that the amount of displacement would be small, and that manual posterior support might reduce the amount of motion observed.

METHODS

Five fresh, whole cadavers were obtained from the University Anatomic Gift Program for the current study. There were three men and two women. Mean age and weight of the cadavers were 83.2 years and 61.2 kg, respectively. Medical records and imaging were reviewed to ensure that none of the cadavers had pertinent cervical spine pathology. Unstable C5–C6 ligamentous injuries were created by a fellowship-trained orthopedic spine surgeon. Anteriorly, the anterior longitudinal ligament, intervertebral disc, and posterior longitudinal ligaments were sharply transected. Posteriorly, the posterior ligamentous complex was sharply incised as well. Instability was confirmed with range of motion using Gardner wells tongs.

An electromagnetic motion analysis device (Liberty device; Polhemus Inc., Colchester, VT) was used to assess the amount of angular and linear motion during each maneuver. The Liberty device uses electromagnetic fields to establish the three-dimensional position and orientation of its sensors. The Liberty detects angular motions with a precision of 0.3 degrees within its optimal operating range of 10–70 cm. This technology has been used extensively in previous studies to document motion in the spine (6–16). For the current study, sensors were fixed to the lamina of C5 and C6 posteriorly using custom-made fiberglass mounting brackets. The relative motion that occurred at C5–C6 was measured as cricoid pressure was applied to the cadavers.

The cadavers were positioned supine. Manual in-line stabilization was applied in all experiments by the same orthopedic spine surgeon. Single-handed cricoid pressure was applied with the dominant hand by the same attending anesthesiologist. The cricoid pressure, which was transduced, was delivered at either 20 or 40 N. The effect of manual posterior cervical spine support on alignment during application of cricoid pressure was also tested. When manual support was applied, the nondominant hand of the same anesthesiologist was placed on the posterior aspect of the cervical spine and applied anteriorly directed supporting pressure. The order of testing was randomized for the hand support (with and without support) and pressure levels (20 or 40 N). Three trials were completed for each of the treatment conditions on each cadaver (Figure 1).

A multivariate analysis of variance was performed on the motion data. The level of significance for all statistical tests was set at <0.05. All statistical analyses were performed using an SPSS statistical software package (SPSS, Inc., version 15.0, Chicago, IL).

RESULT

All motion data in the six planes are presented in Table 1 and Figure 2.

There were no significant differences in the motion observed at the C5–C6 injured segment with the application of 20 or 40 N of anterior cricoid pressure during the trials ($p > 0.05$). The largest displacement observed during the trials was in flexion/extension and averaged 2.95 degrees. Manual posterior cervical spinal support

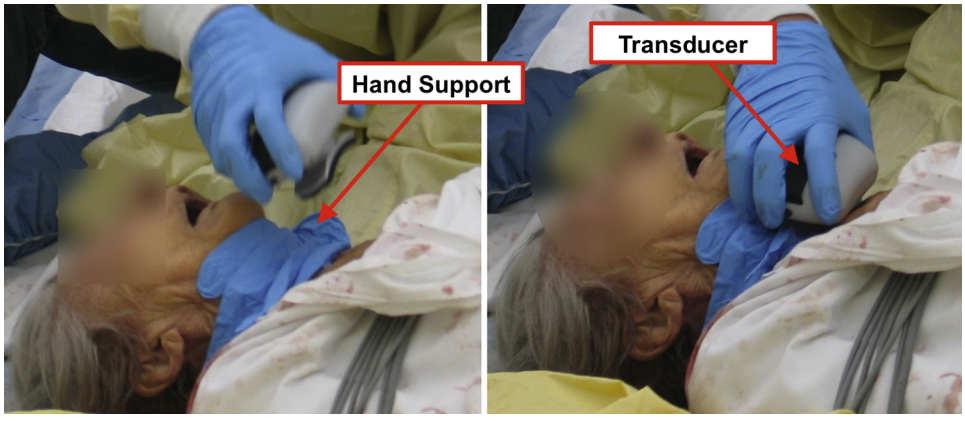

Figure 1. Photograph of cricoid pressure being applied with use of the transducer.