sponses on two separate occasions after protamine administration suggests that the relationship between the elevated IgG and the reactions was more than coincidental.

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References

1. Adourian UA, Shampaine EL, Hirshman CA, Fuchs E, Adkinson NF: High-titer protamine-specific IgG antibody associated with anaphylaxis: Report of a case and quantitative analysis of antibody in vasectomized men. ANESTHESIOLOGY 78:368–372, 1993

2. Wasserman SI, Marquardt DL: Anaphylaxis in Allergy: Principles and Practice. Edited by Middleton E, Reed CE, Ellis EF, Adkinson NF, Yunginger JW. St. Louis, Mosby, 1988, pp 1365–1376

3. Fisher MM, More DG: The epidemiology and clinical features of anaphylactic reactions in anaesthesia. Anaesth Intensive Care 9: 226–234, 1981

4. Weiss ME, Hirshman CA: Anaphylactic reactions and anesthesia, Principles and Practice of Anesthesiology. Edited by Rogers MC, Tinker JH, Covino BG. St. Louis, Mosby Year Book, 1993, pp 2457–2481

5. Levy JH: Anaphylactic Reactions in Anesthesia and Intensive Care. Boston, Butterworth-Hanemann, 1992, pp 161–203

6. Lakin JD, Blocker TJ, Strong DM, Yocum MW: Anaphylaxis to protamine sulfate mediated by a complement-dependent IgG antibody. J Allergy Clin Immunol 61:102–107, 1978

7. Gottschlich GM, Gravlee GP, Georgitis JW: Adverse reactions to protamine sulfate during cardiac surgery in diabetic and nondiabetic patients. Ann Allergy 61:277–281, 1988

8. Stewart WJ, McSweeney SM, Kellett MA, Faxon DP, Ryan TJ: Increased risk of severe protamine reactions in NPH insulin-dependent diabetics undergoing cardiac catheterization. Circulation 70:788–792, 1984

9. Weiss ME, Nyhan D, Peng Z, Horrow JC, Lowenstein E, Hirshman CA, Adkinson NF Jr: Association of protamine IgE and IgG antibodies with life-threatening reactions to intravenous protamine. N Engl J Med 320:886–892, 1989

10. Samuel T: Antibodies reacting with salmon and human protamines in sera from infertile men and from vasectomized men and monkeys. Clin Exp Immunol 30:181–187, 1977

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A Normal Cervical Spine X-ray Does Not "Clear" the Patient with Suspected Cervical Spine Injury

To the Editor:—A recent study reported in the trauma literature[1] may be of substantial import and concern to anesthesiologists managing trauma patients and casts a revealing light on Hastings and Kelley's report[2] of neurologic deterioration after airway management in a patient with an unsuspected cervical spine injury.

Woodring and Lee studied 216 consecutive patients who had suffered cervical spine injuries proven by computed tomography (CT).[1] Although 87% of the patients had signs or symptoms of cervical spine injury at presentation, 5% were asymptomatic with an intact mental status (a further 8% were also asymptomatic but had mild closed head injuries or were intoxicated). Sixty-eight percent of the asymptomatic patients harbored unstable cervical spine injuries. Most importantly, the full cervical spine x-ray series (cross-table lateral (CTL), anteroposterior, and odontoid) missed 23%, and the CTL view 32%, of the cervical spine injuries, half of which were unstable. Furthermore, the CT scan often demonstrated abnormalities of a far greater extent and severity than those demonstrated on the plain x-rays. These data strongly suggest that clinical examination and cervical spine plain films are inadequate for "clearing" the cervical spine in a patient with a known injury mechanism and in particular a patient with an altered mental status. This is cause for much concern because a recent survey of 125 North American hospitals found that one-third of responding institutions relied solely upon the CTL for radiologic evaluation of possible cervical spine injury.[3]

In Hastings and Kelley's report, the patient did initially complain of neck pain, and left arm weakness may have been a further sign of cervical spine injury (as opposed to brachial plexus injury). Woodring and Lee's study suggests that this patient should thus have undergone CT scanning, even though his cervical spine films initially were read as normal.

It has long been routine practice that all patients with a known mechanism of cervical spine injury undergo radiologic imaging, whether or not signs or symptoms are present. Woodring and Lee's report supports this and further suggests that, regardless of plain film results, CT should be added to the imaging evaluation whenever a patient has signs or symptoms of cervical spine injury. Additionally, patients with abnormal x-rays should undergo CT scanning to determine the true extent of the cervical spine injury.

Thus, in airway management of patients with known mechanisms of injury, unless CT scanning has ruled out cervical spine injury, it would seem prudent to initially treat all patients as if the cervical spine was unstable, even if plain films are normal.

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References

1. Woodring JH, Lee C: Limitations of cervical radiography in the evaluation of acute cervial trauma. J Trauma 34:32–39, 1993

2. Hastings RH, Kelley SD: Neurologic deterioration associated with airway management in a cervical spine-injured patient. ANESTHESIOLOGY 78:580–583, 1993

3. Mirvis SE, Diaconis JN, Chirico PA, Reiner BI, Joslyn JN, Militello P: Protocol-driven radiologic evaluation of suspected cervical spine injury: Efficacy study. Radiology 170:831–834, 1989

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A Simple Device to Enable Capnography during Jet Ventilation for Laryngoscopy

To the Editor:—Jet ventilation as described by Sanders[1] for bronchoscopy and modified by Oulton and Donald for use during laryngoscopy[2] can facilitate surgical access to the larynx and is often recommended for use during laser surgery of the airway to eliminate the presence of a flammable endotracheal tube.[3] A disadvantage of this technique is the lack of end-tidal carbon dioxide monitoring. An experimental dog model of translaryngeal jet ventilation demonstrated the correlation of end-tidal carbon dioxide, sampled at the tip of the injector, and arterial carbon dioxide when the respiratory rate was 15 breaths/min, even during obstruction of up to 80% of the cross-sectional area of the upper airway.[4] The authors of this experimental study suggest monitoring end-tidal carbon dioxide during translaryngeal jet ventilation by the use of side-stream sampling through a nasal canula or a low deadspace face mask. To enable side-stream sampling when jet ventilation is used during laryngoscopy, we produced the double lumen injector shown in figure 1. This consists of a 13-Ga metal injector attached to a thumbscrew to which an 18-G 9-cm needle was welded. The entire device was then sand-blasted to decrease specular reflectance. As can be seen in figure 1, the addition of the sampling lumen does not appreciably increase the size of the injector or the potential for the device to interfere with surgery. The injector is clamped to the base of the laryngoscope and attached to a high-pressure gas source and a side-stream sampling device.

The capnographic tracings in figure 2 illustrate the results obtained while sampling from the modified injector of figure 1 during suspension laryngoscopy. These tracings were obtained with an infrared analyzer (OR SARACAP, PPG Industries, Lenexa, KS) while sampling at 110 ml/min through a 10-foot catheter. A muscular 49-yr-old man weighing 100 kg presented for biopsy of the vocal cords. His history is notable for moderate chronic obstructive pulmonary disease and former intravenous use of heroin and amphetamine. The airway was unremarkable. General anesthesia was induced and maintained with fentanyl, propofol, succinylcholine, and vecuronium. A 7-mm oro-

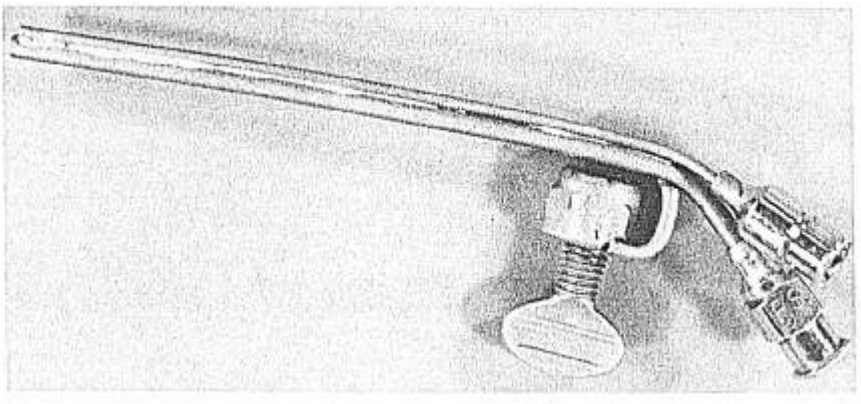

Fig. 1. Addition of a second lumen to the injector to permit side-stream sampling.