Cardiovascular Support Drugs during Thoracic Epidural Analgesia

To the Editor—Lundberg et al. reported that a moderate dose of dopamine (4 μg·kg⁻¹·min⁻¹) was sufficient to maintain the mean arterial pressure and cardiac output at adequate levels during thoracic epidural analgesia.

In a similar study, we assessed circulatory changes following the continuous infusion of ephedrine, dopamine, or dobutamine during thoracic epidural analgesia in elderly patients (71 ± 5 yr, mean ± SD). When systolic arterial pressure was restored to the pre-block values by a continuous infusion of ephedrine at a rate of 31 ± 17 μg·kg⁻¹·min⁻¹, dopamine at 6.9 ± 2.9 μg·kg⁻¹·min⁻¹, or dobutamine at 4.4 μg·kg⁻¹·min⁻¹, left ventricular stroke work index was restored by dopamine or dobutamine, and was increased above the pre-block value by ephedrine. This increase was greater with ephedrine than with dopamine or dobutamine (P < 0.05). Cardiac output was restored by the three drugs to the same degree. However, central venous pressure was increased more with dopamine or dobutamine than with ephedrine (P < 0.01), and pulmonary capillary wedge pressure was increased more with dopamine than with ephedrine (P < 0.05). Therefore, our data suggest that ephedrine among these three drugs is best for the control of arterial pressure, and dobutamine is better than dopamine in improving cardiac function during thoracic epidural analgesia.

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REFERENCES


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Prolonged Sinus Arrest Following Coronary Bypass Surgery

To the Editor—Conduction disturbances after coronary bypass surgery have been reported to occur in as many as 20% of cases. These disorders, often transient, have been attributed to hyperkalemia, inadequate cardioplegia, or atrial ischemia. We report the development of prolonged sinus arrest attributed to air embolization of a right coronary artery bypass graft.

A 57-yr-old male with a history of inferior myocardial infarction underwent coronary bypass grafting after cardiac catheterization revealed high-grade (>80%) proximal lesions of the right, circumflex, and left anterior descending coronary arteries. While the patient was being warmed on bypass, the electrocardiogram showed atrial activity with periods of ventricular arrest, and A-V pacing was temporarily instituted (fig. 1A). Several minutes after bypass was discontinued, a small air bubble was noted to traverse the right coronary graft, and spontaneous atrial activity ceased. Atrial pacing restored hemodynamic stability and was, therefore, continued in the postoperative period (fig. 1B). Examination of the postoperative electrocardiogram revealed absence of sinus activity, a slow nodal rhythm, and a

![LED II](image)

**FIG. 1.** A. Ventricular arrest while warming on bypass; atrioventricular pacing instituted. B. Atrial arrest following air embolization of the right coronary graft; atrial pacing started. C. Electrocardiogram at discharge.
new right bundle-branch block. Atrial pacing was maintained until normal sinus rhythm returned 5 days later. There was no enzymatic evidence of myocardial infarction in the perioperative period. One week later, at discharge, the electrocardiogram showed normal sinus rhythm and a persistent right bundle-branch block (fig. 1C).

We believe that air embolization of the conduction system occurred during surgery and resulted in prolonged sinus arrest. This case emphasizes the diverse etiologies of post-bypass conduction disturbances and underscores the benefits of atrial pacing capability after coronary bypass surgery.

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**Epidural Fentanyl is Not Effective for Analgesia for Extracorporeal Lithotripsy (ESWL)**

*To the Editor:*—We recently reported our experience using epidural fentanyl (2–3 μg/kg in 15–20 ml normal saline) for pain relief during extracorporeal shock wave lithotripsy (ESWL) in 100 patients.1 Good to excellent analgesia was obtained in 96 patients. The onset of analgesia was quick and, since there was no sympathetic or motor blockade, recovery time was extremely short. Apart from a 54% incidence of mild to moderate postoperative pruritus (easily treated with naloxone), there were virtually no other side effects. Within a short time, the technique became the standard anesthetic regimen for ESWL procedures at our institution. However, after we had successfully completed more than 200 cases, we suddenly discovered, to our bewilderment, that this “proven” anesthetic technique no longer provided consistent analgesia for the procedure. The bizarre, albeit educational, circumstances involving our discovery is the subject of this correspondence.

One of the urologists (Paul Sonda, M.D.) was the first to note that his failure rate in crushing stones with the ESWL procedure was high. He suspected that the foam adhesive tape (Microfoam®, 3M Company) we had been using to secure the epidural catheter to the patients’ backs and flanks to make the site of injection watertight might be the cause of the high failure rate. We replaced the foam tape with Op-Site® (a very thin plastic material; Smith and Nephew Company), and there was immediate improvement in the number of stones being fractured. Unfortunately, at that time, a number of patients began reporting discomfort and pain with the ESWL treatment under epidural fentanyl analgesia. We suspected that the air in the texture of the foam adhesive tape might be responsible for diminishing the intensity of the shockwave delivered to the patient.

With the assistance of the manufacturer of the ESWL machine (Dornier), we conducted a study to determine if the various types of adhesive tape used to affix the epidural catheter to the back had any effect on shockwave pressure transmitted to the kidney stone.

During routine testing of the ESWL unit, the amount of force delivered to the F2 point (focal point 2, i.e., the stone position; F1 point being the electrodes of the spark plug) at 20 kv (kilovolt) setting with 1500 shocks averages 1200 bars per shock. Since one bar equals 14.2 PS1, the amount of pressure delivered to the F2 point is approximately 17,040 PS1 per shock wave (1200 bars × 14.2 PS1).

The material to be tested (adhesive tape, etc.) was mounted or taped on the base of a test frame, which, in turn, was mounted on the ellipse containing the spark plug. A transducer was mounted in the test frame at the F2 site. The distance from the F2 site to the material to be tested was 12.5 cm, and the distance of the material being tested from the tip of the ellipse was approximately 1 cm. The pressure generated by the shock wave was measured via the transducer with a 100 bar to 1 volt sine wave step-down read out on an oscilloscope. Fifty to 100 shocks were delivered at a 20-kv setting using the ECG’s internal pacers set at 100 per minute. The results are shown in table 1.

We concluded that the reduction in force of the shockwaves by the foam tape in our original study was