

## CASE REPORTS

copy eliminate airway edema and foreign body aspiration from consideration and establish the diagnoses of PVCM. Once PVCM is diagnosed, reassurance and sedation with 0.5–1.0 mg midazolam given intravenously is recommended in the acute phase as a temporary measure for this benign condition, instead of aggressive airway intervention. All patients should be referred for psychiatric evaluation, anxiolytic therapy, speech therapy, and otolaryngologic follow-up.

## References

1. Rodgers JH, Stell PM: Paradoxical movement of the vocal cords as a cause of stridor. *J Laryngol Otol* 1978; 92:157–8
2. Kellman RM, Leopold DA: Paradoxical vocal cord motion: An important cause of stridor. *Laryngoscope* 1982; 92:58–60
3. Kattan M, Ben-Zvi Z: Stridor caused by vocal cord malfunction associated with emotional factors. *Clin Pediatr* 1985; 24:158–60
4. Skinner DW, Bradley PJ: Psychogenic stridor. *J Laryngol Otol* 1989; 103:383–5
5. Snyder HS, Weiss E: Hysterical stridor: A benign cause of upper airway obstruction. *Ann Emerg Med* 1989; 18:991–4
6. Hammer G, Schwinn D, Wollman H: Postoperative complications due to paradoxical vocal cord motion. *ANESTHESIOLOGY* 1987; 66:686–7
7. Michelsen LG, Vanderspek AFL: An unexpected functional cause of upper airway obstruction. *Anaesthesia* 1988; 43:1028–30
8. Sukhani R, Barclay J: Paradoxical vocal cord motion: An unusual cause of stridor in the recovery room. *ANESTHESIOLOGY* 1993; 79:177–80
9. Arndt GA, Voth BR: Paradoxical vocal cord motion in the recovery room: A masquerader of pulmonary dysfunction. *Can J Anaesth* 1996; 43:1249–51
10. Tousignant G, Kleiman SJ: Functional stridor diagnosed by the anaesthetist. *Can J Anaesth* 1992; 39:286–9
11. Rodenstein DO, Francis C, Stanescu DC: Emotional laryngeal wheezing: A new syndrome. *Am Rev Respir Dis* 1983; 127:354–6
12. Appelblatt NH, Baker SR: Functional upper airway obstruction—A new syndrome. *Arch Otolaryngol* 1981; 107:305–6
13. Patterson R, Schatz M, Horton M: Munchausen's stridor: Non organic laryngeal obstruction. *Clin Allergy* 1974; 4:307–10
14. Cormier YF, Camus P, Desmeules MJ: Non-organic acute upper airway obstruction: Description and a diagnoses approach. *Am Rev Respir Dis* 1980; 121:147–50
15. Murphy PJ, Langton JA, Braker P, Smith G: Effect of oral diazepam on the sensitivity of upper airway reflexes. *Br J Anaesth* 1993; 70:131–4
16. Groves ND, Rees JL, Rosen M: Effects of benzodiazepines on laryngeal reflexes—Comparison of lorazepam and diazepam. *Anaesthesia* 1987; 42:808–14

Anesthesiology  
1998; 89:519–21

© 1998 American Society of Anesthesiologists, Inc.  
Lippincott-Raven Publishers

## Perforation of the Right Ventricle with a Coronary Sinus Catheter during Preparation for Minimally Invasive Cardiac Surgery

David C. Abramson, M.B.Ch.B., F.F.A.(S.A.),\* Andrew G. Giannotti, B.A.†

PERFORATION of the right atrium or ventricle with vascular catheters or wires has been reported many times. With the advent of minimally invasive cardiac

surgical procedures, new technologies in monitoring and catheter placement are evolving. One such system of monitoring catheters has been developed by Heartport, Inc. (Redwood City, CA). This case report illustrates inadvertent right ventricular perforation with the proprietary endocoronary sinus catheter inserted *via* the internal jugular vein.

\* Associate Professor.

† Medical Student.

Received from the Department of Anesthesiology, University of Texas Houston Health Science Center, Houston, Texas. Submitted for publication November 25, 1997. Accepted for publication March 26, 1998.

Address reprint requests to Dr. Abramson: University of Texas Houston Health Science Center, 6431 Fannin MSMB 5.020, Houston, Texas 77030. Address electronic mail to: dabramso@anes1.med.uth.tmc.edu

Key words: Anesthesia; complications; heart.

### Case Report

A 63-yr-old, 1.65-m tall, 57-kg woman presented for minimally invasive coronary revascularization surgery. Preoperative history and physical examination were unremarkable except for an allergic re-

## CASE REPORTS

sponse to intravenous contrast material. Electrocardiogram revealed sinus rhythm without signs of ischemia, and laboratory values were within normal limits.

The patient was sedated with intravenously administered midazolam, and standard monitors were placed. Anesthesia was induced and maintained with sodium thiopental, fentanyl, and pancuronium, and a double-lumen endotracheal tube was placed.

The Heartport system facilitates open heart surgery *via* small thoracotomy incisions. Venous drainage to the bypass machine is through a catheter inserted *via* a femoral vein, which radiologically guided to the junction of the superior vena cava and the right atrium. Oxygenated arterial blood is returned *via* the femoral artery. A balloon-tipped catheter is advanced *via* the femoral artery and placed just distal to the aortic valve for injection of cardioplegic solution once on bypass. Once extracorporeal circulation is established, the balloon is inflated to isolate the heart from the systemic circulation (an internal "aortic crossclamp"). Nine- and 11-French sheaths are then placed into the right internal jugular vein to permit placement of a pulmonary artery stent and coronary sinus catheter, the latter to be used for retrograde cardioplegic solution administration if required. Once catheters are placed, internal mammary artery dissection takes place *via* small thoracotomy incision; exposure is aided with single lung ventilation.

In the current case, the right internal jugular vein was cannulated easily with the two sheaths. Placement of the pulmonary artery stent was uneventful. A transesophageal echocardiography probe was then placed, and normal cardiac anatomy and function were recorded. With the aid of the transesophageal echocardiography and C-arm fluoroscopy, multiple attempts to pass the coronary sinus catheter were made. This is a balloon-tipped catheter with a J-shaped terminal that is stiffened with an internal guide wire; radioopaque dye is used to inflate the balloon, and distal pressures may be transduced. Each time the coronary sinus was thought to have been entered, the guide wire was extended through the tip of the catheter, the catheter tip was advanced over the wire, the balloon was inflated to note distal pressures, and radioopaque dye was injected *via* the lumen to confirm placement. After struggling for 20 min, however, the procedure was abandoned, and the surgeon was invited to proceed. The central venous pressure, measured now for the first time, was 12 mmHg. Gradually, the patient's heart rate increased and blood pressure decreased, which responded initially to small bolus doses of phenylephrine. When this no longer had the desired therapeutic effect, increasing doses of epinephrine were used; a diagnosis of allergic response to the intravenous dye used during catheter placement was entertained. Full cardiopulmonary resuscitation followed before the cardiac surgeon performed a median sternotomy on the already prepared and draped patient. The pericardium was seen to be tense with blood and this was incised. Drainage resulted in return of blood pressure and heart rate to baseline. The central venous pressure had increased to 15 mmHg at the time of incision. An obviously bleeding puncture site in the right ventricle was easily repaired. The minimally invasive procedure with its attendant catheter placement was abandoned, and successful revascularization of the left anterior descending artery was achieved with cardiopulmonary bypass on her cardioplegic-arrested heart (aortic crossclamp applied). The postoperative course was uneventful, and the patient was discharged home well.

## Discussion

Minimally invasive cardiac surgery has developed in response to the suggestion that nonpump coronary re-

vascularization resulted in better left ventricular preservation.<sup>1</sup> The current drive toward cost containment has led to surgical and anesthesia techniques intended to permit early discharge of the patient.<sup>2</sup> Coronary artery bypass grafting using internal mammary arteries *via* a limited anterior thoracic incision is gaining acceptance as a surgical technique.<sup>3</sup>

Complications associated with central venous cannulation are well described and include pneumo- and hemothorax, air embolism, pneumo- and hydromediastinum, and injury to local structures.<sup>4</sup> All of these may be associated with cardiovascular collapse. There are multiple reports regarding cardiac perforation with a wide variety of catheters, ranging from pacing electrode catheters to catheters placed for long-term parenteral nutrition.<sup>5-10</sup> Usually, the perforation is localized to the right atrium; the right ventricle is the next most common site, and even the superior vena cava has been perforated on rare occasion. Diagnosis is not commonly made; in a review of 67 published cases, Chabanier *et al.*<sup>10</sup> noted a cardiac perforation rate of 5.9%, with a postmortem diagnosis made in 53% of patients. Onset of symptoms ranged from < 1 h after insertion (as in our report) up to 19 days. Circulatory arrest and irreversible collapse were common findings, but insidious symptoms, most commonly arrhythmias, often led to misleading diagnoses, the most common being pulmonary embolism. Often, the inability by nursing staff to aspirate from the catheter was later found to signify perforation.<sup>10</sup>

Despite the presence of radiologic and echocardiographic diagnostic equipment, we did not make the appropriate diagnosis until median sternotomy was performed. At the time of cardiovascular collapse, the transesophageal echocardiography picture was not helpful diagnostically. Initially, we entertained the diagnosis of allergic reaction to intravenous contrast media. In retrospect, the time course from injection of the material until clinical signs of collapse became evident was too long.

The high mortality associated with cardiac perforation with venous catheters (up to 85%) should arouse suspicion with any symptoms after placing a central intravenous line. Correct positioning of the catheter should be confirmed by either radiologic or echocardiographic study.<sup>11</sup> Treatment, when possible, unfortunately is also associated with high mortality; the best option appears to be formal surgical drainage of the tamponade and closure of the perforation. Pericardiocentesis is not highly successful, with a mortality rate approaching 62%.<sup>10</sup>

## CASE REPORTS

## References

1. Akins CW, Boucher CA, Pohost GM: Preservation of interventricular septal function in patients having coronary artery bypass grafts without cardiopulmonary bypass. *Am Heart J* 1984; 107:304-9
2. Westaby S: Coronary surgery without cardiopulmonary bypass: Rationale and evolution of technique, *Techniques for Minimally Invasive Direct Coronary Artery Bypass (MIDCAB) Surgery*. Edited by Emery RW. Philadelphia, Hanley & Belfus, 1997, pp 3-8
3. Lytle BW: Minimally invasive cardiac surgery (editorial). *J Thorac Cardiovasc Surg* 1996; 111:554-5
4. Dawood MM, Trebbin WM: Complications associated with central venous cannulation. *Hosp Practice* 1991; 26:211-9
5. Eide J, Ødegaard E: Cardiac tamponade as a result of infusion therapy: A potentially amenable complication of central venous catheters. *Acta Anaesthesiol Scand* 1983; 27:181-4
6. Iglesias A, Maroñas JM, Rufilanchas JJ, Figuera D: Perforation of the right ventricle and cardiac tamponade caused by a venous catheter. *Postgrad Med J* 1977; 53:225-6
7. Fort ML, Sharp JT: Perforation of the right ventricle by pacing catheter electrode: Two cases of asymptomatic perforation with survival. *Am J Cardiol* 1965; 6:610-3
8. Appel TF, Harbrecht PJ: Right ventricle perforation by polyethylene catheter. *Am Surg* 1971; 37(2):91-4
9. Halevy A, Adam Y, Reif R, Eshchar J: Perforation of the right ventricle and pericard by a central venous catheter during total parenteral nutrition. *J Parenter Enter Nutr* 1982; 6:460-1
10. Chabanier A, Dany F, Brutus P, Vergnoux H: Iatrogenic cardiac tamponade after central venous catheter. *Clin Cardiol* 1988; 1:91-9
11. Frog M, Berggren L, Brodin M, Wickbom G: Pericardial tamponade caused by central venous catheters. *World J Surg* 1982; 6:138

Anesthesiology  
1998; 89:521-4

© 1998 American Society of Anesthesiologists, Inc.  
Lippincott-Raven Publishers

## Electrical Fires in Hewlett-Packard Monitors Due to Saline Contamination

Deborah S. Reynolds, M.D.,\* Edward Plant, B.S.,† M. Lee Bancroft,‡ Koren V. Kanadianian,§ Mark E. Comunale, M.D.¶

DESPITE the exclusive use of nonflammable anesthetic agents, the operating room remains an environment rich in the potential for fires.<sup>1</sup> Over the last 10 yr, an

enormous amount of new electronic technology has been added to the operating room environment. At the same time, there has been a relaxation of electrical codes, which no longer requires operating rooms to have isolated power with line isolation monitors.<sup>2,3</sup>

We incorporated the HP M1276-61050 transport monitoring system (Hewlett-Packard Company, Andover, MA) into our practice, but subsequent use of the monitoring system uncovered a serious potential fire hazard. This hazard was partially attributable to equipment design and partially to user technique. We report on a series of three operating room fires and on the equipment design changes and personnel training undertaken to prevent this serious problem.

### Case Reports

A 64-yr-old woman undergoing coronary artery bypass grafting was monitored using our department's standard monitoring. All electronic monitoring was performed using the HP Component Monitoring System (CMS or Merlin) using both a six- and an eight-module satellite rack (fig. 1). Approximately 1 h after connecting the patient monitors and before instituting cardiopulmonary bypass, the monitoring screens on the CMS went blank. The smell of burning plastic was

\* Instructor in Anesthesia, Harvard Medical School.

† Biomedical Engineer, Beth Israel Deaconess Medical Center.

‡ Associate in Anesthesia, Harvard Medical School.

§ Cardiac Anesthesia Technician, Beth Israel Deaconess Medical Center.

¶ Assistant Professor of Anaesthesia, Harvard Medical School.

Received from the Division of Cardiac Anesthesia, Department of Anesthesia and Critical Care, Beth Israel Deaconess Medical Center and Harvard Medical School, Boston, Massachusetts. Submitted for publication August 20, 1997. Accepted for publication April 1, 1998. Laboratory support provided by Hewlett-Packard Company, Andover, Massachusetts.

Address reprint requests to Dr. Reynolds: Division of Cardiac Anesthesia, Department of Anesthesia and Critical Care, Beth Israel Deaconess Medical Center, 330 Brookline Avenue, Boston, Massachusetts 02215.

Key words: Anesthesia; electronic monitoring; short circuit.

# National Fire Protection Association: Health Care Facilities Handbook, Fifth edition. Edited by Klein BR. Quincy, National Fire Protection Association, 1996.