Case Series

Intravenous Adenosine for Surgical Management of Penetrating Heart Wounds

John Kokotsakis, MD
Panagiotis Hountis, MD
Nikolaos Antonopoulos, MD
Elian Skouteli, MD
Thanos Athanasiou, MD
Achilleas Lioulias, MD

Accurate suturing of penetrating cardiac injuries is difficult. Heart motion, ongoing blood loss, arrhythmias due to heart manipulation, and the near-death condition of the patient can all affect the outcome. Rapid intravenous injection of adenosine induces temporary asystole that enables placement of sutures in a motionless surgical field. Use of this technique improves surgical conditions, and it is faster than other methods. Herein, we describe our experience with the use of intravenous adenosine to successfully treat 3 patients who had penetrating heart wounds. ***(Tex Heart Inst J 2007;34:80-1)***

The management of penetrating cardiac wounds can be especially difficult due to the urgent nature of the surgery and the consequences of handling a beating heart. Sudden malignant arrhythmias in an already hypovolemic patient can cause rapid circulatory derangement and death. We successfully used intravenous adenosine to induce temporary circulatory arrest in 3 patients who had penetrating cardiac wounds.

Case Reports

Patient 1

A 22-year-old man arrived at our emergency department in near-death condition with a 2-cm penetrating knife wound to the lower left thoracic wall. The patient was hypotensive, with a systolic blood pressure of 50 mmHg. He had decreased heart sounds, dyspnea, and tachycardia of approximately 180 beats/min.

A rapid flow of intravenous fluid was started, and the patient was transferred to the operating room without delay. We performed a median sternotomy and relieved the pericardial tamponade. The entry wound, which was covered with thrombus, was approximately 1 cm in length on the anterior wall of the right ventricle.

Patient 2

A 24-year-old man was brought to our emergency department with 3 penetrating wounds to his left lateral thoracic wall, from an unknown instrument. His condition gradually deteriorated, even after the evacuation of 250 cc of blood through a thoracic drainage tube. The patient had sinus tachycardia (120 beats/min) and was hypotensive (85/60 mmHg). Ultrasonography of the heart revealed pericardial tamponade. The patient was transferred to the operating room. After performing a median sternotomy, we found the source of the bleeding—an approximately 0.5-mm-diameter wound that extended into the root of the pulmonary artery.

Patient 3

A 48-year-old man was transferred to our emergency department in stable condition with a 4-cm-long wound to his upper left abdominal wall, after an explosion. Abdominal and thoracic computed tomographic scans revealed a metal pellet that was embedded in his diaphragm. General surgeons had investigated the wound, but they had not found the piece of metal. Cardiac ultrasonography disclosed the location of the metal pellet and showed a bloody pericardial collection without tamponade. We performed a median sternotomy and removed the metal pellet, which was embedded in the inner surface of the diaphragm and was projecting into the pericardial space. There was a tear in the apex of the heart.

Key words: *Adenosine/administration & dosage; cardiac surgery; emergencies; heart arrest/induced; heart injuries/surgery; infusions, intravenous; wounds, penetrating/surgery*

From: *Departments of Cardiac Surgery (Drs. Antonopoulos, Hountis, and Kokotsakis), Evangelismos General Hospital, 10676 Athens, Greece; Anesthesiology (Dr. Skouteli), Sotiria General Hospital, 11527 Athens, Greece; Cardiac Surgery (Dr. Athanasiou), Saint Mary's NHS Trust, London W2 1NY, United Kingdom; and Thoracic Surgery (Dr. Lioulias), Sismanogleio General Hospital, 15127 Athens, Greece*

Address for reprints: *Panagiotis G. Hountis, MD, Veikou 9-11, 11146 Galatsi-Athens, Greece*

E-mail: panos_hountis@hotmail.com

Surgical Management

In these 3 patients, our 1st goal was to control the blood loss, which we did digitally. The anesthetist then injected 3 mg of adenosine through a large-bore vein catheter. After about 20 to 40 seconds, asystole occurred long enough (10–25 sec) to enable accurate placement of simple Prolene 5-0 sutures (Ethicon Inc., a Johnson & Johnson company; Somerville, NJ) reinforced with Teflon felt pledgets. The adenosine was administered 2 to 4 additional times, as needed, until the final repair was completed. After uneventful postoperative courses of 4 to 6 days, all 3 patients were discharged from the hospital.

Discussion

The outcome for patients with penetrating heart injuries depends upon rapid on-site resuscitation and prompt transport of the victim to the closest cardiothoracic surgical center. The patient must be taken to the operating room without delay. The nature of the injury dictates the choice of repair technique. Current techniques include simple sutures with or without Teflon felt pledgets; the use of both the instruments and the experience gained from beating-heart operations; the use of automatic-suture instruments, at least as a temporary solution; and the application of extracorporeal circulation. Extracorporeal circulation with cardioplegic arrest is used mainly for traumas to multiple heart chambers, or for wounds that involve the coronary circulation.[1]

We have used adenosine to achieve brief asystole, in order to provide enough time for accurate suturing in a motionless surgical field. Rapid intravenous injection of adenosine causes temporary atrioventricular block and asystole, because adenosine inhibits sinus and atrioventricular node function. Asystole is usually apparent after 20 to 40 sec.

Adenosine has a very brief effect. In our patients, asystole lasted for 10 to 20 sec. Sinus rhythm was easily restored after that period. Two to 4 administrations of 3 mg allowed time not only for the precise placement of sutures, but for the checking of all cardiac chambers for concurrent injuries.[2,3]

Side effects of adenosine include facial flushing (44% of cases), thoracic discomfort (40%), dyspnea (28%), headache (18%), 1st- and 2nd-degree atrioventricular block (3%), and hypotension (2%). Acute bronchoconstriction has also been reported.[4] Our patients experienced no side effects.

Proper and expeditious suturing of heart wounds is crucial. Adenosine-induced asystole occurs quickly and allows sufficient time for accurate suturing in a motionless surgical field. Our case series and another report[4] describe very good outcomes from this application of intravenous adenosine. We consider this easily learned and implemented technique one that affords substantial advantages over other approaches.

References

1. Lim R, Gill IS, Temes RT, Smith CE. The use of adenosine for repair of penetrating cardiac injuries: a novel method. Ann Thorac Surg 2001;71:1714-5.
2. Schwarte LA, Hartmann M. Intentional circulatory arrest to facilitate surgical repair of a massively bleeding artery. Anesth Analg 2003;97:339-40.
3. Robicsek F. Induced ventricular fibrillation in the management of aortic arch trauma. Ann Thorac Surg 2002;73:342.
4. DuBose RA, Karmy-Jones R. Delayed diagnosis and management of an "occult" stab wound to the heart. Am Surg 2005;71:879-81.