Cardiac arrest after administration of Omnipaque radiocontrast medium during endoluminal repair of abdominal aortic aneurysm

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We describe a case of acute cardiovascular collapse in a patient with end-stage renal failure undergoing endoluminal repair of an abdominal aortic aneurysm. The 61-yr-old man suffered cardiac arrest shortly after administration of radiocontrast medium (Omnipaque), during deployment of the endovascular device. He had received the same contrast solution for diagnostic angiography on the previous day. He was successfully resuscitated and recovered completely. The differential diagnosis and management are discussed.

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Endoluminal repair is a new, minimally invasive technique for surgical treatment of abdominal aortic aneurysms,1 involving transfemoral insertion of an intraluminal prosthetic graft into the infrarenal aorta. Using this technique, the aneurysm sac is excluded from the circulation. The intraluminal prosthesis is anchored to the normal aortic wall above and below the aneurysm using an expandable balloon or self-expandable metallic hooks. The technique requires image intensifier guidance and intra-arterial administration of radiopaque contrast. If used successfully, this method carries the advantages of reductions in morbidity, blood loss, hospital stay and cost.2 However, vessel rupture and failure of technique can lead to conversion to an open surgical repair. In addition, reactions to radiocontrast media (RCM) contribute a significant morbidity.

Case report

A 61-yr-old male was admitted for endoluminal repair of an abdominal aortic aneurysm (EAAA). A 6 cm infrarenal aortic aneurysm had been diagnosed 4 months previously. His aneurysmal disease was suitable for endovascular graft placement and he was offered the treatment. He had a history of ischaemic heart disease and malignant hypertension with end-stage renal failure. He was on regular haemodialysis using a well-functioning arteriovenous fistula and maintained a good quality of life. His current medication included Imdur, diltiazem, aspirin and erythropoietin. He denied allergy to food or drugs. Preoperative investigations showed: haemoglobin 12.4 g dl−1; platelets 192×109 litre−1; Na+ 138 mmol litre−1; K+ 5.2 mmol litre−1; urea 13.6 mmol litre−1 and creatinine 677 mmol litre−1.

On the day of admission the patient had aortography to define the precise position of the aortic stent; 100 ml contrast solution (Omnipaque) was used. For the endovascular procedure the next day, anaesthesia was induced with fentanyl 100 μg, propofol 140 mg and atracurium 50 mg, and maintained with isoflurane (inspired concentration 0.8–1.2 vol%) and nitrous oxide in oxygen (nitrous oxide >50%/oxygen >30%). The right radial artery and right internal jugular vein were cannulated for continuous monitoring of arterial pressure and right atrial pressure and the patient was transferred to the operating theatre. Surgery proceeded uneventfully for 2 h. There was no administration of additional drugs, colloid or blood during this period. For maintenance therapy, 0.9% sodium chloride 5 ml kg−1 h−1 was given.
Immediately before the attachment of the endoluminal stent to the aortic wall, 250 ml radiopaque contrast (Omnipaque) was injected via the right femoral artery to determine that it was positioned correctly. Shortly afterwards, the deployment of the graft with expansion of the balloon was completed.

Five min after administration of the radiocontrast material, the arterial pressure decreased markedly. The systolic arterial pressure decreased progressively and reached 20 mm Hg despite administration of increments of ephedrine (30 mg in total), epinephrine 1 mg and crystalloids 1000 ml. The heart rate was 130 beat min⁻¹ but no cardiac output was detected. Indirect cardiac massage was started as electromechanical dissociation arrest was evident on ECG. Arterial blood gases at this time were: pH 7.4, \( P_{\text{aCO}_2} \) 4.77 kPa, \( P_{\text{aO}_2} \) 24.0 kPa, base excess −1.8 and \( \text{SaO}_2 \) 99.6% with \( F_{\text{IO}_2} \) 1.0. No bronchospasm, rash or periorbital oedema were observed.

Resuscitation continued for 20 min and comprised epinephrine 3 mg and norepinephrine 1 mg, four units of blood, crystalloids 2000 ml and colloids 1000 ml.

Within 30 min, the systolic arterial pressure stabilized at 70–80 mm Hg with a continuous infusion of epinephrine 0.1 \( \mu \)g kg⁻¹ min⁻¹, and the decision not to convert to open surgery was taken. The procedure was completed successfully.

The patient was then admitted to the intensive care unit. An acute systemic reaction to RCM was suspected at that time. Blood was obtained for measurement of serum mast-cell tryptase concentration, routine blood tests and clotting screen. Hydrocortisone 100 mg i.v. was included in the treatment and continuous venovenous haemofiltration started.

The patient’s condition improved dramatically over the next few hours, and he was weaned off inotropic support. He was extubated the following morning and was discharged almost 100% excreted unchanged through the kidneys, with no free fluid in the retroperitoneal space, favouring the diagnosis of acute anaphylaxis as a cause of the cardiac arrest.

**Discussion**

Reactions to RCM are well documented. Most case reports concern diagnostic radiological procedures without general anaesthesia. Mild adverse reactions, mostly vasodilatation, occur in 3% of all contrast radiological examinations, but it is the idiosyncratic anaphylactoid reactions that may be fatal and which cause the greatest clinical concern. Few case reports describe systemic anaphylactic reactions mediated via antigen-specific IgE antibodies formed from previous exposure to RCM, but the reactions are thought to have mainly an anaphylactoid character.

There are two groups of RCM: ionic, hyperosmolar (1500 mOsm kg⁻¹) or first-generation solutions, and the newer, second-generation, non-ionic, hypo- and iso-osmolar (350–700 mOsm kg⁻¹) agents. It is widely accepted that the first-generation RCMs are more toxic and more immunogenic and therefore responsible for a higher morbidity, including allergic reactions.

There is emerging evidence, however, that some of the newer non-ionic hypo-osmolar RCMs can trigger a true anaphylactic reaction, directly activating IgE antibodies. Iopamidol and ioversol, for example, have chemical structures that resemble the ‘mirror molecules’ of succinylcholine and other neuromuscular blocking agents. They have two identical side-chains containing quaternary ammonium groups which can cross-link to IgE molecules. In theory, these new RCM could be more immunogenic than the older first-generation ionic hyperosmolar solutions, but there are insufficient data to confirm this. However, new preparations have significantly lower overall toxicity and fewer side-effects.

In 1970, Ansell reported life-threatening reactions to the first-generation ionic contrast agents in 0.01–0.02% of all radiological examinations but more recently the incidence of a fatal outcome has been reported in only 1 in 40 000 administrations. In 1992, Lieberman reported an incidence of severe, but not necessarily fatal, anaphylactoid reactions in 1–2% of all contrast studies, perhaps attributable to the growing number of radiological investigations and previous under-reporting of adverse reactions. With the introduction of the new generation of non-ionic, low-osmolar RCM, this risk has been reduced 5–10 fold.

Iohexol (Omnipaque) is another new, second-generation RCM. It is the most frequently used x-ray contrast medium for arteriography, cardioangiography, urography, hysterosalpingography, gastrointestinal tract and CT investigations. It is a non-ionic, monomeric, tri-iodinated, water-soluble, isotonic solution containing iohexol 140–350 mg ml⁻¹. It is almost 100% excreted unchanged through the kidneys within 24 h of administration. It is less than 2% protein bound and has no detectable metabolites.
Our patient had an acute anaphylactic reaction to contrast medium under general anaesthesia and during a major surgical intervention. The reaction occurred in typical fashion, 3–5 min after administration of the contrast medium and followed re-exposure to the allergen (RCM).\(^{10}\) The lack of other signs of an acute allergic reaction (e.g. bronchospasm, histamine release) made the recognition of anaphylactic shock very difficult. Furthermore, the time of the reaction coincided with surgical manipulation of the aorta, when aortic rupture is particularly difficult to exclude. Unchanged haemoglobin concentration, lack of abdominal distension and a good response to high doses of epinephrine did not support the diagnosis of vessel rupture. Although we did not suspect an anaphylactic reaction immediately, we ruled out massive blood loss in the operating theatre, and the surgery was completed successfully.

Tryptase is a neutral protease concentrated in the secretory granules of mast cells. It serves as a specific marker for mast-cell activation and its concentration is linearly related to histamine release.\(^{11}\) We accepted the 5-times-normal-range tryptase concentration as proof of our clinical diagnosis.\(^{12}\) (Concentrations above 20 ng ml\(^{-1}\) are considered indicative of an anaphylactoid or anaphylactic reaction.)

This patient had end-stage renal failure but we followed the renal physicians’ recommendation not to haemodialyse before the operation. It is unlikely that haemodialysis before surgery would have influenced the severity of the reaction because the patient was already sensitized to RCM during the previous radiological examination (diagnostic angiography). However, we feel that haemofiltration in the immediate postoperative period contributed considerably to the speed of recovery because of the more rapid elimination of inflammatory mediators.\(^{13}\)

We believe that this is the first case of anaphylactic shock reported in a patient undergoing EAAA, a technique which is increasingly being used. It is important to draw the attention of anaesthetists to the potential allergenicity of RCM, in particular when contrast solutions are used during surgery. In the case of an acute anaphylactic reaction, prompt recognition and early and continuous treatment remain important for a successful outcome.

References