

Massive blood loss during graft harvesting with the reamer irrigator-aspirator

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Introduction

Reamer-Irrigator-Aspirator (RIA) is an FDA approved device for the reaming and preparation of the femoral medullary canal. It consists of a single-pass reamer that is connected to an irrigation bag and a suction device through two separated ports and tubes, allowing the surgeon to simultaneously irrigate and ream the canal and aspirate the reaming. The reaming can then be collected to a pot attached to the aspiration tube.

RIA was first introduced to reduce the incidence of fat embolism and thermal necrosis. Its indications have expanded since then, and it is now used for intramedullary debridement for the treatment of osteomyelitis and for bone graft harvesting.^{1,2}

Several advantages of RIA, compared to graft harvesting from the iliac crest, have been reported: reduced postoperative pain, minimal donor site morbidity and larger volume of autologous bone graft.^{3,4} However, the RIA is not without complications: amongst others, the possibility of considerable blood loss has also been mentioned.^{1,2,4-6}

We present two cases where massive bleeding was encountered during graft harvesting using RIA. Furthermore, we present our technical suggestions for the management of this potentially life threatening incident.

Case presentation

Case one

The first case was a 51-year-old male, otherwise healthy; who needed a bone graft as part of a second stage Masquelet technique for the treatment of acute traumatic bone loss from his proximal tibia. Three months earlier he had sustained a right open tibia fracture (Gustilo IIIB) with a large bone loss after a motorcycle road traffic accident. Despite the extensive bone and soft tissue loss, it was decided to salvage the limb. The initial debridement and spanning external fixator was followed by additional debridement of bone and soft tissues and internal fixation with locking plate. The missing extensor mechanism off patella was protected by tension by wire. Lastly, the tissue was covered with Latissimus Dorsi free muscle flap. For the graft harvesting, the femoral canal diameter was measured preoperatively on the CT and found to be 13mm. A 13.5 mm RIA head was used. During reaming, significant blood loss from the femoral canal was detected. The bleeding occurred within two minutes since the initiation of reaming. At that point, reaming and suction stopped and the RIA plastic tube was left in the canal as a tamponade. By calculating the difference between the fluid volume in the suction bag and the total administered volume of irrigating fluid we were able to see that approximately 2000 ml of blood had been lost. The patient developed mild tachycardia (less than 100/min) and was appropriately resuscitated by the anaesthetic team. Tranexamic acid was administered and the graft harvesting procedure was abandoned.

Case two

The second case was a 55-year-old male, otherwise healthy, who required bone graft as part of a second stage Masquelet technique for the treatment of persistent chronic osteomyelitis of the left distal femur. Osteomyelitis and the previous bone debridement had resulted in a cavitary bone defect on the anterolateral aspect of the bone. The contralateral femur was used for graft harvesting. No imaging of the femur was available preoperatively, so the femoral canal diameter was measured intraoperatively with the canal diameter measuring guide under image intensifier and found to be 13 mm. A 14 mm RIA head was used. The advancement of the RIA progressed slowly and with difficulty because of the hardness of the bone. After approximately six minutes, by calculating the difference between the fluid volume in the suction bag and the total administered volume of irrigating fluid, a blood loss of approximately 1500 ml was estimated. Reaming and suction were paused and the RIA plastic tube was left in the canal. The patient remained haemodynamically stable, tranexamic acid was administered and we carefully resumed the procedure 5 minutes later. We utilized standard femoral reamers to broaden the rest of the isthmus up to 13.5 mm and we then completed the reaming and graft harvesting with the RIA reamer. No further significant blood loss was noticed.

Discussion

RIA has become increasingly popular as graft harvesting device. Although it is advantageous compared to standard iliac crest graft harvesting in terms of graft volume, donor side morbidity and possibly quality of graft,^{1,3,7} it is not without complications. Previous studies have highlighted the possibility of fractures and cortical breaching.^{1,2,4-6} Although the possibility of significant blood loss has also been mentioned in the majority of these studies,^{2,4-6,8} there are not many reported cases with massive blood loss. Quintero et al.⁶ reported on 20 cases; one of them developed intraoperative hypovolemia. Based on their experience, they would expect a blood loss between 200 and 500 ml in RIA cases. The purpose of this study is to share our

experience of this potentially disastrous event. In our cases the blood loss was significantly higher (1500 and 2000 ml) and happened very quickly. In our first case, it happened within the first two minutes of the reaming and before the first 3 l bag of irrigation fluid was finished. In the second case, it happened within six minutes of reaming.

These incidents occurred in otherwise healthy patients without history of bleeding disorders, coagulopathies or recent use of anti-DVT agents.

The technique that we used is the one described in the manufacturer's Op-tech brochure and in the literature.⁴

Our experience confirms that massive bleeding is a complication that should be considered in any case scheduled for RIA. Also, appropriate precautions and measures should be implemented. Our technical recommendations based on this experience are:

- A. All patients consented for RIA procedure should be informed about the risk of significant bleeding and the possibility of transfusion.
- B. All patients should be cross-matched for four units of blood.
- C. The anaesthetics team and theatre staff should be informed during the team briefing about the possibility of massive and rapid blood loss.

The method of calculation of the total blood loss should be explained thoroughly. It is based on the deduction of the administered fluid from the total volume in the suction bag. It is easier to start the reaming with a new, full 3 l irrigation bag and a completely empty suction bag. By deducting the volume given through the irrigation from the fluid volume in the suction bag we are able to calculate the blood volume lost at any given time. We stop and calculate the blood loss for every l of fluid administered through the irrigation. At the same time we take into account any blood and fluid on the floor or drapes.

- A. If significant bleeding does occur, reaming and, most importantly, suction should be stopped for 5 minutes. It is suggested to leave the plastic tube into the canal to provide a tamponade effect. After the patient had been assessed and managed by the anaesthetic team and the clearance to proceed has been given, resume reaming cautiously but quickly, following the same steps in calculating the blood loss.
- B. If there is a need to abandon the case, it is suggested to finish the reaming of the canal quickly with the use of standard reamers up to the same diameter as started with RIA, in order not to leave the intramedullary canal half-reamed, which could act as a stress riser for possible fracture.
- C. If difficulty to advance the RIA reamer through the isthmus is encountered and the case is prolonged, which inadvertently increases the amount of blood loss, it is suggested to use standard reamers to widen the isthmus until 0.5 mm less than the chosen RIA head and then continue with the RIA (with the standard reamers, ream only through the isthmus and not the whole femur length; otherwise, provide the vent).

Subsequently to these incidents we tested the use of cell saver in an attempt to re-administer the lost blood to the patient. It proved that the cell saver filter could not handle the large volume of fluid, as it is designed to be used with small amounts of fluids collected from the

usual surgical field. It was necessary to pause the procedure several times to allow time for the cell saver to filter the fluid volume. This proved to be time-consuming and impractical.

We also tested the use of adrenaline solution 1:200.000 (we prefer 1 mg in 3 l of saline) diluted in the irrigating fluid. The use of adrenaline for haemostasis purposes has been successfully used for a long time in the shoulder arthroscopy in order to control intra-articular bleeding and improve visualization.⁹ Detailed information about its efficiency will be reported in our future adequately powered study. However, we think that, especially because it is a safety issue, it is worth mentioning here that the first data show reduced blood loss to less than 100 ml in the first four cases.

Based on our experience with the described cases we conclude that:

- A. During the use of the Reamer-Irrigator-Aspirator, attention must be paid to the risk of a potential major, life threatening blood loss.
- B. It is recommended that the surgeon has implemented precautions and measures for the early diagnosis of this intraoperative complication and the appropriate management should it happen.

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None.

Conflicts of interest

None.

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