International Orthopaedics (2019) 43:1793–1798
https://doi.org/10.1007/s00264-018-4163-9

ORIGINAL PAPER

Major emergency orthopaedic surgery in patients with a concomitant acute coronary event following trauma

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Received: 9 June 2018 / Accepted: 14 September 2018 / Published online: 1 October 2018
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Abstract

Introduction This paper is a short series description of our experience with five cases managed surgically for orthopaedic trauma and who suffered meanwhile an acute coronary event.

Materials and methods Five polytrauma, multiply fractured patients were treated in our institution for various lesions, including an open femur and knee articular fractures, major fractures around the pelvis and hips. They had suffered around the same time an acute coronary event complicating the orthopaedic management. One patient was treated for the orthopaedic condition as a delayed emergency, with a five day retard due to pre-operative pulmonary oedema. Four patients had cardiac evaluation, angiogram or echocardiogram. The patients were managed by a multi-disciplinary team.

Results One patient died post-operatively due to multiple complications, and four patients survived with a good functional outcome.

Conclusions Patients with acute orthopaedic polytrauma presenting concomitant acute coronary events should be treated by multi-disciplinary teams, allowing early surgical management in a safe cardio-vascular and stable haemodynamic status.

Keywords Orthopaedic trauma · Acute coronary event · Heart · Cardiac ischaemia · Myocardial infarction · Open fracture · Pelvis fracture

Introduction

Orthopaedic trauma with major fractures with a concomitant acute coronary event is a management dilemma for surgeons and intensivists. There is thus far very little published literature on the management of these unfortunate patients. The first published literature of mortality following hip fracture surgery in patients with recent myocardial infarction [1] described a series of 11 patients who underwent emergency hip surgery in the setting of an acute myocardial infarction and described a mortality of 45.4% at one month and 63.5% at six months. Another published report, which also happens to be the largest series published, had all of 25 patients [2]

Both the previous reports consisted of relatively straight forward orthopaedic injuries where surgery was limited to either a hemiarthroplasty or dynamic hip screw fixation. We present a series of five cases, four of whom had suffered from major polytrauma and one a domestic fall, all five of whom had major fractures and all five of whom had developed a concurrent acute coronary event. Unlike the previous reports, while the one patient with a fracture neck femur was managed with an uncemented bipolar arthroplasty, and one patient with a comminuted open grade 3B fracture femur and fracture patella underwent un-reamed interlocking nailing of the femur and patellectomy, the other three patients needed complex hip joint reconstruction or pelvic surgery. The series is presented not just for the difficult perioperative intensive management of these patients but also for the particularly complicated orthopaedic reconstructive effort that these patients needed.

Materials and methods

There were five patients who were hospitalized in our centre, two males and three females (Table 1) following trauma. All have given informed consent.

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Table 1 List of patients and their details

S. no	Age	Sex	Orthopaedic diagnosis	Co-morbidities	Acute coronary event	ASA grade	Pre-op wait time	Course in hospital and result
1	72	M	Fracture neck L femur	DM, CKD, HT	ANTEROLATERAL ISCHEMIA, CAD, TROP T POSITIVE, EF 40%	4	2 days	Developed Atrial fibrillation, Rt MCA infarct with Hemiplegia, and acute kidney disease and expired on the 6 th post op day
2	70	F	Comminuted fracture acetabulum, central dislocation femoral head, fracture neck femur, fracture greater trochanter	DM, CKD, HT, severe anaemia (6.3 mg/dl)	OLD CAD, PRESENT ANTEROLATERAL ISCHEMIA, TROP T POSITIVE, EF 40%	4	5 days	Had preop pulmonary oedema, recovered, hypoalbuminemia, treated, recovered and discharged home
3	61	F	Old secondary OA L Hip with comminuted fracture neck and trochanter and sub trochanteric region	DM, L high frontal haemorrhagic contusion, Hypothyroidism Hypocalcaemia Anaemia 6.5 mg/dl)	ANTEROLATERAL ISCHEMIA, TROP T POSITIVE, EF 68%	3	1 D-AY	Post op tachycardia and hypocalcaemia, recovered, and discharged home
4	50	F	Fracture superior and inferior pubic rami R side with comminuted fracture R sacral Ala with dislocation of R SI joint Transverse # S3	DM, Fracture Ribs with hemopneumoth-orax	Inferolateral ischemia,	3	3 days	Recovered and Discharged home
5	35	M	Comminuted open grade 3 B fracture Femur and Comminuted fracture patella R	Smoker	Acute Anterior wall ST elevation Myocardial Infarction, Trop T positive, EF 30% LDH 924 U/L (normal 114–240) CPK-MB 650u/L (normal upto 25)	4	10 h	developed acute pulmonary oedema in the post-operative period, patchy lung consolidations with haemorrhagic pleural effusion needing intercostal drainage, needed non-invasive ventilation, haematuria needing adjustment of heparin dosage, 3 units of packed cells and 4 units of FFP, recovered and discharged.

DM diabetes mellitus, *CKD* chronic kidney disease, *HT* hypertension, *CAD* coronary artery disease, *TROP T* troponin T, *EF* ejection fraction, *LDH* lactate dehydrogenase, *CPK-MB* creatinine phosphokinase–muscle and brain

Four patients had suffered a major poly trauma, and one had sustained a trivial fall at home. One patient with the acute ST elevation MI was hospitalized in 2013, and the other four in 2018. All the five patients were assessed by an orthopaedic surgeon, a cardiologist, an intensivist and anaesthesiologist and a nephrologist where needed, pre-operatively. Four of the patients had an echocardiography done to assess cardiac function, and one of them did not have it done since she had undergone a recent angiogram as well as echocardiogram in the last two months. Patient number 1 underwent a straight forward uncemented bipolar hemiarthroplasty for a sub capital fracture neck of femur. The patient number 2 had a grossly comminuted fracture of the R acetabulum with fracture of the femoral neck and trochanter with central dislocation of the femoral head (Fig. 1).

This patient was seen to be severely anaemic and the same was corrected with transfusions. The patient suffered from an episode of pulmonary oedema and was treated for the same

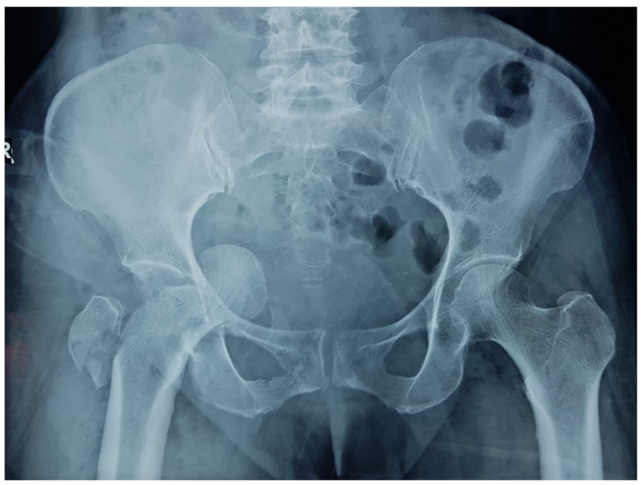

Fig. 1 Anteroposterior radiograph of case 2 showing a comminuted fracture greater trochanter and acetabulum with central dislocation femoral head. The sub-capital fracture neck of femur was not made out on the radiograph or CT but was seen per operatively

and recovered. After a delay of five days due to these issues, the patient underwent surgery for the hip.

At surgery, after gently manipulating the fractured loose intra-pelvic femoral head out, the acetabulum was assessed. The entire inferior 2/3rd of the acetabulum was seen to be essentially absent, having been scattered around the site in multiple pieces, with only the dome intact (Fig. 2).

The fractured posterior column of the acetabulum was identified and brought up to the intact portion of the acetabulum and was stabilized using a plate with screws, the remnant broken piece of the quadrilateral plate of the acetabulum was brought out from its intrapelvic location and made to lie in the floor. And after reaming the remnant of the dome to expose bleeding bone, bone graft harvested from the femoral head was packed in the acetabular cavity to reconstruct the acetabulum.

The grafts were then protected with a special uncemented cage to help support the prosthetic acetabular shell and a total hip replacement was carried out.

The post-operative radiograph (Fig. 3) showed a stable hip construct and the patient was allowed to sit up and mobilize her limb immediate post op. Patient has since become ambulant with support at three month follow-up.

Case 3 had suffered a comminuted sub-trochanteric fracture with pre-existing osteoarthritis of the hip and underwent a primary total hip with a long stem implant (Fig. 4).

Case 4 had sustained a superior and inferior pubic ramus fracture anteriorly on the right with an ipsilateral comminuted fracture of the Sacral Ala with a displacement of the SI joint. The patient also had a transverse fracture of the sacrum at the level of around s4. The patient was operated through an Ilio-inguinal approach, and the sacro-iliac joint was reduced and stabilized using a plate with screws from anteriorly and the pubis was stabilized using another plate anteriorly (Fig. 5).

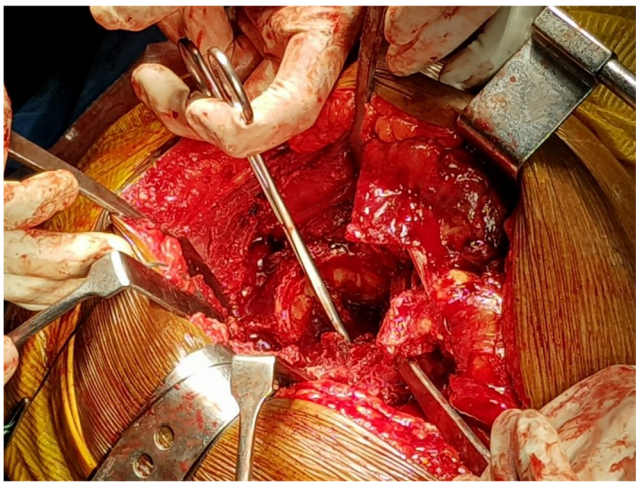

Fig. 2 Per operative image showing the intact dome with the rest of the acetabulum absent, with the floor formed by the pelvic soft tissues and rectum

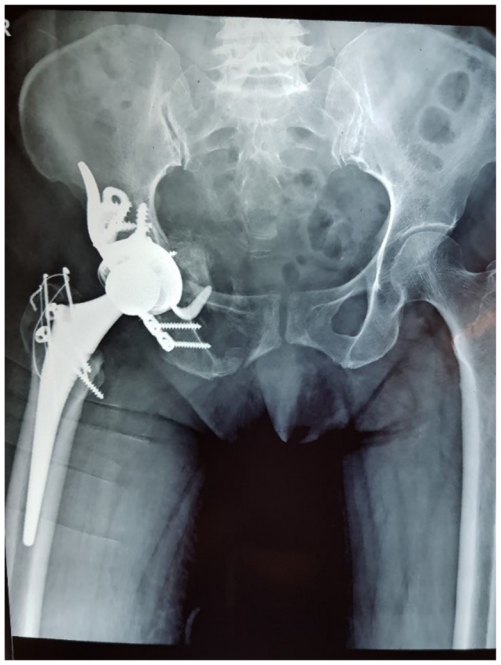

Fig. 3 Post-operative radiograph—case 2 showing a stable total hip replacement construct. The greater trochanter was reattached using a combination of screws and k wires.

Case 5 underwent an un-reamed interlocked nailing of the comminuted fracture shaft femur after wound debridement and a patellectomy and quadriceps repair.

Patients 1, 2, 3 and 4 were treated with low molecular weight heparin in the preoperative period. The heparin was withdrawn in the peri-operative period and restarted 12 h post op. Patient 5 reached us 10 h after the injury and was immediately taken up for surgery and was treated with unfractionated heparin in the post-operative period. Of the five patients in the series, patient 1 developed an acute episode of atrial fibrillation in the post-operative period which was being treated when he also developed a cerebrovascular accident and left hemiplegia. The patient also progressed to an acute renal shut down and died in the 6th post-operative period. Patient 5 developed acute pulmonary oedema, patchy lung consolidations and a haemorrhagic plural effusion needing intercostal drainage, and a fall in oxygenation needing non-invasive ventilatory support. He recovered and subsequently underwent a coronary angiogram after his general condition stabilized. He was seen to be suffering from a total proximal left anterior descending artery occlusion. But since his repeat echocardiogram showed a left ventricular aneurysm, he was advised medical management of his cardiac condition. He is now in his 5th post-operative year and has since quit smoking and has returned to productive life as a driver. The other three patients did well except for tachycardia in two which was treated appropriately. The patient with poor cardiac ejection fraction of 40%(case 2) and who had developed pre-operative pulmonary oedema was seen to be severely hypoalbuminemic

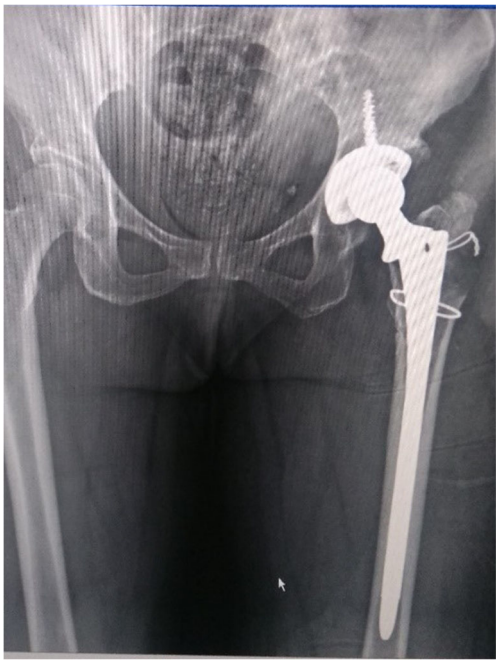

Fig. 4 Post-operative radiograph of case 3 showing a stable total hip prosthetic replacement

in the post-operative period, and this was corrected with albumin infusions taking care to avoid fluid overload. The patient was put on a strict fluid intake restriction of 1500 ml per day.

Case 3 was seen to have persistent levels of significantly low serum calcium which were treated with repeated infusions of intravenous calcium chloride until the serum calcium levels normalized. Both case 2 and case 3 also received supplementation of vitamin D in the post-operative period.

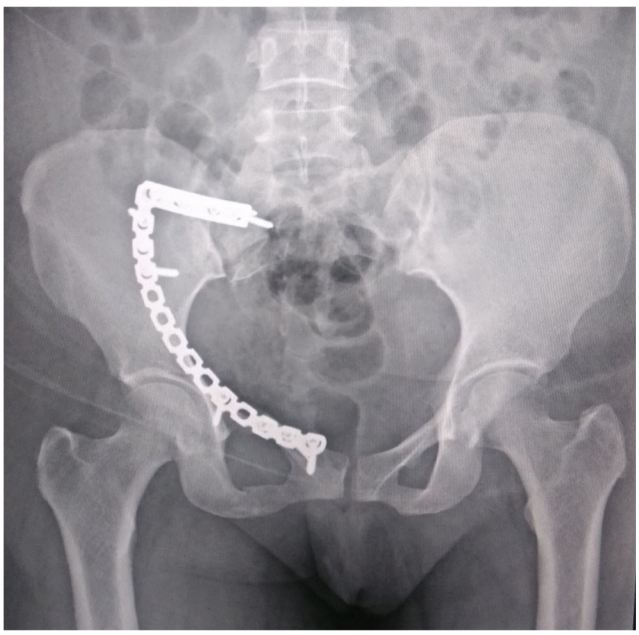

Fig. 5 Post-operative radiograph of case 4 showing a stabilized R Hemi Pelvis

Discussion

Elective surgery is ideally deferred after a recent cardiac event. However, in the setting of a major trauma, especially of the hip, pelvis or the femur, delaying surgery comes with its attendant complications such as bed sores, deep vein thrombi, pulmonary embolisms, infections in open fractures etc. which are detrimental in themselves. Besides, cardiac intervention will involve the use of antithrombotic agents which in the presence of unstable fractures may lead to excessive bleed. Also, the use of thrombolytics is contraindicated in fresh trauma and in the post-operative period. It is by now established that timely operative intervention within 48 hours of a hip fracture significantly improves morbidity and mortality [3] . Hence in such patients, deferment of orthopaedic surgery is not an option despite the high risks.

Holcomb et al.[4] have matched 20,590 surgical and 41,180 nonsurgical stent patients and suggested that the incremental risk of adverse cardiac events with noncardiac surgery adjusted for surgical characteristics was 2.8% during the first 6 weeks, 2% between six weeks and six months, and 0.9% between six months and 24 months. This suggests that the first six weeks post-coronary stenting is the highest risk period for peri-operative complications for noncardiac surgery. Hence, in their editorial comment [5] Emmanouil S. Brilakis and George D. Dangas suggest that stenting should be avoided if at all possible in patients known to require noncardiac surgery within six weeks and where indicated, stenting should be deferred until after noncardiac surgery. They also suggest that if at all emergency revascularization were to be absolutely indicated, then a coronary artery bypass surgery may be considered where clinically feasible. Thus, the risks of a coronary intervention in patients in our series are significant and are unlikely to improve morbidity and mortality.

The series of 11 patients described by Komarasamy et al.[1] suggested a mortality within one month of 45.4% and at six months of 63.5%. David Stanley et al. suggested a slightly lower mortality rate of 28% within one month and 40% within six months in their series of 25 patients [2].

They postulate this to be due to them having used heparin in their patients unlike the previous study where only aspirin was used. It has been published that in aspirin-treated patients with acute coronary syndrome without ST elevation, short-term unfractionated or low molecular weight heparin therapy halves the risk of myocardial infarction or death [6].They also suggest that another reason may be their using uncemented implants unlike the previous study where predominantly cemented implants were used. Use of cement is suggested to cause a transient but significant reduction in the cardiac output of up to 33% and a reduction in the stroke volume of about 44% [7] which might have adversely impacted the patients in the previous series.

Menendez ME et al.[8] identified risk factors for acute myocardial infarction among inpatients after total joint arthroplasty surgery from a retrospective cohort of 3,096,791 procedures. The risk factors included advanced age, male gender, total hip arthroplasty, low house hold income, history of cardiac disease, congestive heart failure, valvular heart disease, pulmonary circulation disorder, cerebrovascular disease, peripheral vascular disorder, coagulopathy, deficiency anaemia, fluid and electrolyte disorders and occurrence of post-operative complications. In our series of patients, two were 70 years or above in age, one 61 and two 50 and less. Also, the one patient we lost was a male who developed multiple post-operative complications. The other risk factors from the list above, which were seen in one or the other of our series of patients, include total hip arthroplasty surgery, history of cardiac disease, congestive cardiac failure in two patients, iron deficiency anaemia in two patients and hypocalcaemia.

Bass AR et al.[9] also postulated on risk factors for the development of myocardial ischaemia after total hip and knee replacement surgery by measuring high sensitivity troponin T from stored samples from day two after surgery in 394 patients and identified at least 53 patients who had sustained myocardial ischemia of whom only three were clinically identified. They suggested advanced age, diabetes, hypertension, coronary artery disease and tobacco use as potential risk factors although only the first two achieved statistical significance. In our series, four patients suffered from diabetes, two from systemic hypertension and one was a smoker.

Knobe M et al.[10] in their attempt to identify predictive factors for mortality and cardiorespiratory complications after different types of surgical fixation methods for trochanteric fractures suggested a specific mortality of 28.7% which was influenced by a high ASA grade and a high transfusion rate. This is consistent with at least one of our patients who suffered from severe anaemia pre-operatively and who also developed pre-operative pulmonary oedema and who needed multiple transfusions. This patient was managed with a strict restriction of total fluid intake in 24 hours to 1500 ml, including oral and parenteral, to minimize fluid overload.

Burlew CC [11] emphasizes clearly the importance of employing preperitoneal pelvic packing to obtain hemodynamic stability in patients with pelvic bleed, based on the premise that the majority of such bleeds are due to venous bleeding. In at least two of our patients who had significant pelvic injury, haemodynamic instability, if had been present, might have been due to either a pelvic bleed or due to cardiac dysfunction. It is important to make this distinction, since management of these two conditions will differ. Haemodynamic instability due to cardiac dysfunction may be identified from the electrocardiogram as well as an echocardiogram to assess cardiac contractility.

Our series of patients differs from the previous two published series in at least two ways. While the average age of the patients in the previous two series was beyond 80, the average age of our series is 57.6. But, while all the patients in the previous two series were managed with relatively straight forward and simple operations—either an Austin Moore hemiarthroplasty or a dynamic hip screw fixation, only one of our patients underwent bipolar hemiarthroplasty. One patient needed a major exposure of the pelvis on the inside to stabilize the sacroiliac joint and the pubis, and at least two patients needed a complex hip reconstruction with complex total hip prostheses. And the patient with the open fracture femur and fracture patella needed emergency wound debridement and interlocked nailing of the femur as well as a patellectomy. Hence, these cases are being presented not just for their complicating cardiac conditions, but also for the complexity involved in the orthopaedic reconstruction. Our mortality rate of 20% within one month compares favourably with published results. The one death occurred due to a series of events involving multiple organs. All patients were treated in the intensive care unit for at least three to four days post-operatively until it was known that they had stabilized before being shifted to the ward.

Conclusion

Management of these patients is challenging for the medical team involved. But, emergency coronary intervention is unlikely to help decrease, while a delay in orthopaedic intervention will only increase morbidity. Hence, considering the interests of these patients, especially when they are hemodynamically stable, the orthopaedic intervention needs to precede any coronary intervention. Deferring surgery in these patients would only have added to their morbidity and mortality.

Funding There has been no funding source.

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

Ethical approval The presentation of this work has been approved by the hospital ethics committee.

Informed consent Informed consent has been obtained from the patients.

References

1. Komarasamy B et al (2007) Mortality following hip fracture surgery in patients with recent myocardial infarction. Ann R Coll Surg Engl 89:521–525
2. Stanley D et al (2011) The management and mortality of patients undergoing hip fracture surgery following recent acute myocardial infarction. Acta Orthop Belg 77:626–631

3. Sircar P et al (2007) Morbidity and mortality among patients with hip fractures surgically repaired within and after 48 hours. Am J Ther 14:508–513
4. Holcomb CN et al (2014) The incremental risk of non-cardiac surgery on adverse cardiac events following coronary stenting. J Am Coll Cardiology 64:2730–2739
5. Brilakis ES, Dangas GD (2014) Editorial Comment: What to do When a Patient with Coronary Stents needs Surgery. J. Am. Coll Cardiology 64(25):2740–2742
6. Eikelboom JW et al (2000) Unfractionated heparin and low molecular weight heparin in acute coronary syndrome without ST elevation: a meta-analysis. Lancet 355:1936–1942
7. Cark DI et al (2001) Cardiac output during Hemiarthroplasty of the hip. A prospective controlled trial of Cemented and Uncemented prosthesis. J Bone Joint Surg 83-B:414–418
8. Menendez ME, Memtsoudis SG, Opperer M, Boettner F, Gonzalez Della Valle A (2015) A nationwide analysis of risk factors for in-hospital myocardial infarction after total joint arthroplasty. Int Orthop 39(4):777–786
9. Bass AR, Rodriguez T, Hyun G, Santiago FG, Jl K, Woller SC, Gage BF (2015) Myocardial ischemia after hip and knee arthroplasty: incidence and risk factors. Int Orthop 39(10):2011–2016
10. Carow J, Carow JB, Coburn M, Kim BS, Bucking B, Bliemel C, Bollheimer LC, Werner CJ, Bach JP, Knobe M (2017) Mortality and cardiorespiratory complications in trochanteric femoral fractures: at ten year retrospective analysis. Int Orthop 41(11):2371–2380
11. Burlew CC (2017) Preperitoneal pelvic packing for exsanguinating pelvic fracturs. Int Orthop 41(9):1825–1829