

Enhanced Recovery for Neck of Femur Fracture: A Current Concept and Review of Perioperative Interventions

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ABSTRACT

Neck of femur [NOF] fracture is a common and life threatening injury. Prompt treatment and mobilisation will reduce perioperative complications and cut the cost to the health care providers. The current economic environment requires short hospitalisation and early discharge without compromising patient safety. Furthermore, patients with these injuries will benefit from early mobilisation and discharge. The current concept of enhanced recovery is widely accepted with successful outcomes in hip and knee arthroplasty. This can be applied to enhance recovery for neck of femur injuries that can improve outcome and reduce cost. This is a summary of available interventions in enhanced recovery in NOF fracture.

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Key words: Neck of femur fracture Enhanced recovery; Rapid recovery; Perioperative interventions; Fast track

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INTRODUCTION

Enhanced recovery has been implemented across many surgical specialties^[1]. In 1997 an approach to promote rehabilitation with an enhanced recovery program [ERP] was developed for colorectal surgery in Copenhagen^[2] and it was subsequently adopted for orthopaedic patients^[3].

The current evidence suggests that a large proportion of patients benefit from enhanced recovery protocols^[4,5]. There will inevitably be a cohort of patients that will fail to achieve the same benefits from an enhanced recovery protocol as their peers^[6].

A recent study projected that by the year 2033, there will be 100,000 annual patients requiring surgery for proximal femur fractures^[7]. They estimated the cost to the NHS at a staggering £3.6-£5.6 Billion in total care^[7]. Given that the role of ERP is to reduce inpatient stay it is not unreasonable to project that the cost of total care may be reduced if a nationwide ERP is implemented.

An evidence-based summary of interventions and procedures available to achieve enhanced recovery and to reduce hospital stay with better functional outcomes following NOF fracture is presented.

METHODS AND LITERATURE SEARCH

A health-care electronic database (MEDLINE, EMBASE, Cochrane library), Google scholar and web of knowledge search was conducted to identify reported perioperative measures producing enhanced recovery in NOF fracture management. We used the following keywords to conduct our literature search: “neck of femur fracture”, “enhanced recovery”, “rapid recovery”, “perioperative interventions” and “fast track”. We included all studies dealing with ERP in NOF excluding studies published in a language other than English. A summary of these measures is constructed and presented in this review.

Due to the very nature and infancy of this topic there have only been three large studies where an enhanced recovery protocol has

been implemented to full effect^[6,8,9]. We attempted to gather the remainder of our evidence from either large randomised control studies or meta-analyses found in the Cochrane library. We have also used the National Institute of Clinical Excellence (NICE) and the Scottish Intercollegiate Guidelines Network’s (SIGN) established database for other aspects of our evidence. We attempt to consider as many aspects as possible that may play an integral role in a successful enhanced recovery protocol – these have been broadly divided into pre, peri and post operative interventions for ease of classification. There are different interventions divided into three broad classes adopted by established ERPs (Table 1). These will be the focus of our review.

PRE-OPERATIVE INTERVENTIONS

Pre-Operative Scoring

Scoring patients according to pre-injury degree of mobility, age and fracture site has been shown to be a good indicator of identifying high risk patients^[6]. Kristensen and Kehlet have shown that a new mobility score (NMS) (Table 2) of 2-6 or intertrochanteric fracture was associated with a four and 6.5 fold increase in patient’s not regaining their previous mobility and/or not being discharged back to their pre-injury dwellings, respectively. A significant rise was also demonstrated with every additional year added to the patient’s age^[6]. Although length of stay (LOS) was not directly assessed in this study, the significance was in the predictive power (80%) of the NMS as to which patients were at high risk of not achieving pre-operative mobility and not being discharged back to their own residence^[6].

A simple scoring system such as this could be completed upon patient admission and would allow easy and quick identification of high risk patients that may need extra support during their inpatient stay to enhance their recovery.

Patient Education

Patient education can come in the form of physician to patient education – which includes verbal information regarding their inpatient journey; or in the form of leaflets which include information regarding their surgery or LOS. MacFie *et al* implemented a multimodal optimisation process which included patient education, he found that it would lead to reduced patient anxiety and better compliance with rehabilitation^[8].

The available literature in elective arthroplasty surgery highlights

the importance of patient education from an enhanced recovery point. Crowe and Henderson highlighted that with tailored pre-operative education sessions, discharge targets were met earlier (5.4 days versus 8 days) and LOS was shortened (6.5 days versus 10.5 days) compared with normal pre-operative sessions^[10]. A more recent study at Columbia University Medical Centre looked at one-on-one pre-operative educational programmes. It concluded that in lower limb arthroplasty the LOS in hospital was significantly less than the group of patients that did not participate in one-on-one sessions^[11].

The high prevalence of patients with cognitive impairment poses a hurdle to ERP. A recent study analysed excluded patients from the HEALTH and FAITH studies found that the overall prevalence of cognitive impairment (including dementia) to be 27.9%^[12]. Unfortunately as this cohort of patients is likely to lack the capacity to understand or retain any information given it will be difficult to counsel them in the pre-operative setting. The information in these circumstances is given to the patient’s family – the aim is to involve the family in the multi-disciplinary process from the start which may help facilitate talks regarding discharge planning when the time comes.

This is a very subjective area and is heavily dependent on the quality and reliability of the information given to the patients; however if the information given is up to date, accurate and most importantly given in a manner appropriate to the patient then it has the potential to improve the quality of healthcare^[13]. It will help to engage patients and their families in the process of enhanced recovery. We therefore recommend that more research should be invested in this field.

Fascia Iliaca Block and Sparing use of Opioid Analgesia

Inadequate or ineffective analgesia has often been a large contributing factor in the delay of patient discharge from hospital^[14]. Another contributor is the numerous side-effects that opioids have on the elderly population that suffer with fractured NOF^[15].

The fascia iliaca spans from the lower thoracic vertebrae to the anterior thigh and lines the posterior abdomen and pelvis covering the psoas major and iliacus muscles^[16]. The fascia iliaca compartment is a potential space that allows the easy delivery of local anaesthetic with the aim of anaesthetising one or more of the three main nerves that supply the thigh^[16]. In recent years a number of studies have emerged to assess the validity and effectiveness of pre-operative fascia iliaca compartment blocks in hip procedures^[17-19].

Table 1 Existing Enhanced recovery protocols of proximal femur fractures

Name of Author and Institution	Pre-Operative Intervention						Intra-Operative Intervention			Post-Operative Intervention
	Pre-Op Scoring	Patient Education	Fascia Iliaca Block	Carbohydrate Loading (Nutritional Support)	Surgery <48hours	Liberal Transfusion	Peri-Operative High Flow Oxygen	Invasive Fluid Management	Epidural Anaesthesia and Analgesia	Intensive Physiotherapy with Early Mobilisation
Kristensen <i>et al</i> Hvidovre Hospital[6]	V	X	X	V	V	V	X	X	V	V
McFie <i>et al</i> Scarborough General Hospital[8]	X	V	V	V	V	X	V	V	X	V
Rasmussen <i>et al</i> Vejle Hospital[9]	X	X	X	V	X	V	V	X	V	V

Table 2 New Mobility Score.

Mobility	No difficulty and no aid	With a walking aid	With help from another person	Not at all
Able to get about the house (Indoor walking)	3	2	1	0
Able to get out of the house (Outdoor walking)	3	2	1	0
Able to go shopping (Able to walk whilst shopping)	3	2	1	0

The main findings of decreased post operative visual analogue pain scores and the post operative LOS have been shown^[15,17,19]. Furthermore, a study demonstrated that the technique of fascia iliaca block is learnt quickly (within 5 minutes), required minimal equipment and therefore could be done in the accident and emergency department whilst the patient awaits admission^[18]. This can be the future mode of analgesia, as is currently the case in our institution, in these frail patients that can be generalised and adapted by all trauma units.

Nutritional Support

It is important to note that patients with NOF fracture may often be nutritionally depleted prior to admission^[8] especially those with cognitive impairment. Petersen et al showed that even in the presence of aggressive nutritional support the end point of LOS was only reduced by one day^[20] which is still a gain for the patient and hospital administration. One of the centres implementing an ERP allowed their patients to have fluids up to three hours pre-operatively and administered carbohydrate loading^[8]. The rationale behind this is the attempted attenuation of insulin resistance that occurs as a stress response to surgery^[21]. This stress response has in itself shown to be an independent factor in increasing LOS postoperatively^[22]. The current evidence fully supports pre-operative carbohydrate loading and is an important factor in most ERP^[21,23].

Traditionally patients have been expected to fast for approximately 6 hours pre-operatively – this was mainly to ensure gastric emptying in order to decrease the risk of intra-operative aspiration^[24]. On the other hand, a Cochrane review concluded that there was no difference in aspiration between patients who had fasted a standard 12 hours and those that had fasted a reduced 2-3 hours^[24]. This will not only decrease time taken for theatre but also has been shown to improve patient comfort^[24].

The NICE guidelines on NOF fractures advised centres to refer to their guidelines relating to nutrition in adults^[25].

Aim for surgery within 24 hours

Current guidelines set by the NICE state that if surgery is indicated in patients with proximal femoral fractures it should take place the day of or the following day of admission^[25]. SIGN^[26] and a report posted in 1999 by the National Confidential Enquiry into Peri-operative Deaths (NCE-POD)^[27] recommend that once safe a patient should wait no more than 24 hours for surgery.

NICE deems the possibility of a patient awaiting an operation overnight as unacceptable^[25]. There are numerous studies that look into an increase in the morbidity and mortality rates if a patient is made to wait more than 24-48 hours for surgery^[25,28]. Even though the evidence is of low level^[25], NICE claims that in aggregate the evidence supports the avoidance of delay to theatre. A large meta-analysis demonstrated that early surgery resulted in reduced mortality rates at 1 year as well as reduced post operative pneumonia and pressure sore rates^[29]. Two further studies showed a decrease in mortality for patients undergoing early versus late (more than 48 hours) surgery^[30,31].

A prospective cohort study was conducted in 2004, which specifically looked at outcomes following early surgery (<24 hours) and late surgery (>24 hours), showed that although there was no benefit in mortality or function, there was a statistically significant reduction in LOS by 1.94 days^[32]. Conversely Eriksson et al found no significant difference in LOS but a decrease in adverse events was demonstrated at 3 months^[33].

Although currently the evidence is not conclusive as to whether a

delay in taking a patient to theatre increases morbidity and mortality rates, it is clear that there is no advantage of increasing the delay nor is there a disadvantage in reducing the delay^[25]. On those recommendations most centres [whether they have an ERP or not] opt for early surgery (<48 hours).

In 2012 the department of health updated its best practice tariff for the management of fractured NOFs, which aims to offer financial incentives to trusts that implement certain recommendations^[34] which included time to surgery, enforcing this to be within 36 hours from arrival in an emergency department, or time of diagnosis if an inpatient, to the start of anaesthesia.

Liberal Transfusion Policies

It is generally understood that a Haemoglobin [Hb] of below 8 g/dL signifies severe anaemia and necessitates transfusion^[35], the controversy surrounds moderate anaemia where the Hb is between 8-10 g/dL^[35]. Severe anaemia in the post operative period is already proven to be associated with a raised mortality^[36], however no such association has been found in the moderate anaemia group^[37]. A study performed to assess the need for early blood transfusion in order to improve early post operative mobilisation found that moderate anaemia between 8-10 g/dL does impede post operative rehabilitation and should be used as an incentive to reduce post-operative LOS^[35]. The study showed that a Hb of <10 g/dL was associated with a statistically significant decrease in the ability to walk on the 3rd post operative day, mortality and on time to discharge^[35].

INTRA-OPERATIVE INTERVENTIONS

Epidural Anaesthesia and Analgesia

The development in the anaesthetic and surgical interventions, and the initiation of ERP have shortened the LOS and rehabilitation from several weeks to few days following elective hip arthroplasty^[38]. However, there is evidence of considerable variation in the perioperative care provided for NOF fracture patients^[39].

The anaesthetic techniques can involve general anaesthesia, regional anaesthesia, peripheral nerve block or a combination of different techniques, but there is little evidence to support the superiority of a technique over the other^[40]. In June 2012, the Association of Anaesthetists of Great Britain and Ireland (AAGBI) published new guidelines regarding the management of proximal femur fracture, stating that roughly 50% of the anaesthetists prefer regional anaesthesia and 50% prefer general anaesthesia.

A systematic review of 22 trials found that regional anaesthesia reduces acute post operative confusion^[41]. For the same reason, the Scottish Intercollegiate Guidelines Network has recommended that 'spinal/epidural anaesthesia should be considered for all patients undergoing hip fracture repair, unless contraindicated^[26]. However, there was no significant difference between regional and general anaesthesia in terms of LOS^[26,41].

Berger *et al* assessed the possibility and safety of outpatient total hip arthroplasty under epidural anaesthesia and propofol sedation as part of ERP. A hundred and fifty patients were included in the study, all patients were discharged home the same day, and 131 patients managed to walk with any support at the time^[38].

In a randomised, double-blind, placebo-controlled trial, Epidural anaesthesia and analgesia for hip fracture surgery did not have any impact on the enhanced rehabilitation although it provided greater analgesia without motor block^[42].

Local infiltration of the surgical field can also be used for postoperative pain control. Kerr and Kohan used a mixture of

ropivacain, ketorolac and adrenaline in 325 patients following knee and hip surgery. They found that most of the patients walked with some support 5-6 hours after operation and without any support between 13-22 hours after operation. Also, 71% of the patients were able to go home after one night stay in hospital^[43].

It is also important to adequately balance the duration of the epidural and the pain relief that it supplies versus early mobilisation of the patient. Thus, further studies are required to establish whether regional anaesthesia and analgesia can have a major role in enhanced recovery and reduced LOS in hip fracture patients^[42].

Peri-Operative High Concentration Oxygen

Oxygen plays an essential role in the immune system^[44]. It activates neutrophils which are responsible for the oxidative killing of surgical pathogens, reducing the risk of surgical site infection (SSIs)^[45]. It has been also demonstrated that high concentration inspired oxygen (FiO₂ 80%) approximately doubles the partial pressure of oxygen in the subcutaneous tissue and reduces the incidence of SSIs by almost 50%^[44]. SSIs can extend hospital stay by 3 to 20 days^[46]. In a study of 10061 cases of proximal femoral fractures, 1.05% of patients had prolonged hospital stay and needed more support after discharge^[47].

Several studies in the general surgical population have found that supplemental high concentration oxygen can reduce both SSIs and LOS. Grief et al found the incidence of SSIs was 6% less in the intervention group (FiO₂ 80%), compared to the control group (FiO₂ 30%)^[48]. In a randomised controlled trial (RCT), oxygen delivery index of 600 mL/min/m² was used as part of the post operative goal directed therapy (GDT). The result showed that the median LOS was 11 days in the GDT group compared to 14 day in the controlled group^[49].

An RCT, which provides a large basis for the recommendations made by SIGN regarding Oxygen therapy, states that hypoxaemia may be present from time of admission up to 5 days post operatively^[50]. By monitoring oxygen saturations SIGN have recommended that supplemental Oxygen therapy be given for at least 6 hours post operatively and for 48 hours at night as well as whenever the patient is hypoxaemic^[26].

The evidence shows that high oxygen concentration in the peri-operative period can have a positive impact on patients' outcome and LOS in general surgical population. These findings may be extrapolated into NOF fracture surgery although further studies and research are required.

Optimal Fluid Management

Nutritional depletion not only needs to be addressed pre-operatively as mentioned before, but in the peri-operative period also. Optimal fluid management can be used to ensure an adequate riposte to the inevitable stress response that occurs during surgery. There are two schools of thought with regards to optimal fluid management in the intra-operative phase. The first is using conventional methods of monitoring urine output, blood pressure and central venous pressure; however these measurements are sometimes inaccurate^[51]. The second is the use of more advanced and invasive methods of monitoring that uses goal driven therapy in order to achieve optimisation of cardiac output. Coupled with good oxygen therapy it is expected to improve clinical outcomes in the post operative phase^[52]. There are numerous ways to achieve this including transoesophageal doppler and pulse colour analysis^[53].

A recent systematic review suggested that there was not enough evidence to suggest that intensive fluid management in the peri-operative phase improves post-operative rates of mortality and

adverse events^[53]. One trial did however come to a conclusion that those patients undergoing intensive fluid management had a significantly decreased LOS in hospital (6.2 day reduction) compared with a standard protocol for fluid management (3.9 day reduction) in patients undergoing proximal femur repair^[54]. The review concluded that although one study did show a decrease in the LOS in hospital, the evidence was not strong enough to recommend^[53]. Further evidence is required.

Minimally invasive surgery

There is an established role for minimally invasive surgery (MIS) in elective hip arthroplasty in general with less tissue trauma and reduced LOS as part of enhanced recovery program^[55]. The role of MIS in NOF fracture surgery is a growing concept with scarce evidence in the literature. A recent RCT compared this to the conventional approach and found a significant difference in mobilisation and pain scores favouring the MIS^[56]. This concept can be a vital step in establishing an ERP; however careful consideration must be taken in order to ensure there is no compromise in the insertion and placement of the prosthesis. Therefore we recommend that further evidence is required before recommending the universal use of this concept in the context of enhanced recovery.

POST-OPERATIVE INTERVENTIONS

Wound Infection Prophylaxis

Good management of the post-operative patient's surgical site is an essential part of any proposed enhanced recovery protocol. As discussed earlier, our patient has just suffered a severe insult to their body from both the fracture and surgery. Therefore, adopting all previously mentioned measures should be combined with adequate prophylaxis against post operative surgical site infections.

This cohort of patients who often sustain proximal hip fractures are also at risk of developing urinary and chest sepsis^[57]. A meta-analysis published in 2004 found that prophylactic antibiotics either in the peri or post operative phase significantly reduced the chances of superficial or deep wound infections^[58]. It also shows that using prophylactic antibiotics reduced the incidence of urinary tract infection in the post operative phase, however there was no difference in mortality^[58].

In our institution, it was agreed in collaboration with microbiology and infectious disease consultants that the antibiotics of choice for open reduction and internal fixation of the fracture is a combination of Flucloxacillin and Gentamycin and for hemiarthroplasties is Teicoplanin.

Physiotherapy and Early Mobilisation

Even with fixation of a fracture NOF, there is still a very high chance that an elderly patient will experience some form of disability or dependence post operatively⁵⁶. Therefore it is imperative to reduce this by implementing a well designed post-operative rehabilitation process for patients. The available literature hosts an abundance of information pertaining to different post-operative rehabilitation regimes and their functional outcomes. A large systematic review of all the rehabilitation practices in the elderly post hip fracture surgery showed that in the acute care setting, interventions such as high frequency physiotherapy and occupational therapy as well as post operative review by a geriatrician increased ambulatory agility^[59-61].

The study also concluded that exercise regimes which include treadmill gait retraining, physiotherapy with quadriceps muscle retraining and physiotherapy with neuromuscular stimulation also

were related to increased recovery of ambulation^[62-65]. Furthermore, it was found that intensive occupational and physiotherapist exercise as well as post operative care from a geriatrician significantly decreased LOS^[65].

Although there is no doubt from the evidence that post operative physiotherapy is beneficial, there exists a debate between early and late mobilisation of patients. In the current NICE guidelines they recommend early mobilisation (within 24 hours post operatively)^[25]. This is based on the evidence provided by a single randomised controlled trial looking at early versus late mobilisation of proximal neck of femur fractures^[66]. The study showed that at 1 week post op the early mobilisation group was able to walk further and required less assistance to transfer than the delayed mobilisation group^[66]. 26.3% of patients who were mobilised early were discharged directly home compared with only 2.4% of patients who were mobilised later^[66]. The early mobilisation cohort of patients was also less likely to need high level care compared with the delayed mobilisation group^[66]. Our current practice is to begin mobilising patients as early as 4 hours post operatively if it is safe to do so and their physical condition allows.

Discharge Planning

Ideally discharge planning should begin as soon as the patient is admitted. A discussion with the multidisciplinary team including the patient and their supporting relatives should be had in order to ensure everyone involved in the patient's care is aware of how long the patient is expected to be in the acute setting. This will allow for earlier provisions for discharge planning such as the need for additional support at home such as rehabilitation equipment, modification to the home environment and the arrangement of early physiotherapy appointments. A meta-analysis and systematic review conducted in 2013 found that early discharge provisions reduced the chances of readmission and reduced the length of stay in the instances where patients were readmitted^[67]. This is of particular use in the elderly population who may need more help in terms of service provisions than younger patients.

From a more qualitative point of view, the involvement of the patient and their relatives in the discharge process has also been shown to have a close relationship with post operative satisfaction. The department of health released a document in 2010 stating that there was a significant variation ($p < 0.001$) between the oxford knee scores of post operative knee replacement patients and their satisfaction with their inpatient experience^[68].

CONCLUSION

Enhanced recovery is a combination of principles based quite firmly in evidence. It has already made a significant impact to patients undergoing elective colorectal and orthopaedic procedures and has been well supported by the NHS community as a whole^[69].

However the authors appreciate that there are numerous variations and inherent differences between elective and emergency patients that by their very nature make it much more difficult to implement. We appreciate that in that respect enhanced recovery is still in its infancy. The evidence supporting enhanced recovery in the emergency setting is still scarce; therefore we call for further investigation and research into this area. More specifically we must look at whether using the various interventions mentioned above in unison can improve morbidity, mortality, LOS and most importantly patient experience. In the interim however this article has presented a thorough evidence base that fully supports the application of the above individual

interventions with a smaller but optimistic triad of studies showing the successes of enhanced recovery pathways in neck of femur fractures.

CONFLICT OF INTERESTS

There are no conflicts of interest with regard to the present study.

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