Short-term morbidity factors associated with length of hospital stay (LOS): development and validation of a Hip Fracture specific postoperative morbidity survey (HF-POMS).

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Abstract

Background: We aimed to describe and quantify postoperative complications in the older hip fracture population, develop and validate a hip fracture postoperative morbidity survey tool (HF–POMS).

Methods: A prospective clinical observation study of patients (≥ 70 years) admitted for emergency hip fracture surgery, was conducted across three English National Health Service hospitals. Outcome data items were developed from the Postoperative Morbidity Survey (POMS), Cardiac-POMS, hip fracture postoperative literature and orthogeriatric clinical team input. Postoperative outcome data were collected on days 1, 3, 5, 8 and 15; 341 patients participated.

Results: A 12-domain HF-POMS tool was developed with acceptable construct validity on all HF–POMS days. Patients with high perioperative risk scores as measured by the NHFS and ASA grade were more prone to develop HF–POMS defined morbidities. High morbidity rates occurred in the following domains; renal, ambulation assistance, pain and infectious. Presence of any morbidity on postoperative days 8 and 15 was associated with subsequent length of stay of 3.08 days (95% CI 0.90 – 5.26, p= 0.005) and 15.81 days (95% CI 13.35 – 18.27, p = 0.001) respectively. Observed average length of stay was 16.9 days. HF–POMS is a reliable and valid tool for measuring early postoperative complications in hip fracture patients. Additional domains are necessary to account for all morbidity aspects in this patient population compared to the original POMS.

Conclusion: Many patients remained in hospital for non-medical reasons. HF-POMS may be a useful tool to assist in discharge planning and randomised control trial outcome definitions.

Key words – hip fracture, postoperative morbidity survey, outcomes, complications, mortality, length of hospital stay

Introduction

Elderly patients undergoing emergency hip fracture surgery have a high risk of perioperative complications and death. In the UK, postoperative mortality ranges between 7-11% at one month, 16-28% at six months and 22-37% at one year [1 2]. In-hospital postoperative morbidities are more frequent (17-50%) and often complex. A significant proportion of hip fracture survivors have decreased ability to perform activities of daily living; 50% do not regain their pre-fracture functional status and 10-20% of those admitted from home require long term institutional care [2]. Accurate identification, quantification and care of short-term morbidity after hip fracture surgery is important since these conditions are strongly associated with mortality and length of hospital stay [3], impact long-term survival [4], and resource management.

Current hip fracture care lacks a standardised categorisation of clearly defined early undesirable postoperative clinical outcome measures that can individually or collectively result in lower quality of life. The postoperative morbidity survey (POMS, appendix 1) [5] was developed from a heterogeneous elective patient population producing a nine-domain tool, each domain with specific defined criteria, to provide consensus in measurement and reporting of outcome following surgery. Its primary purpose is to identify the presence of complications that delay hospital discharge. The tool was further validated in several studies [3 6-8] demonstrating acceptable inter-rater reliability, accuracy in capturing criteria defined morbidities, and association with length of hospital stay (LOS). Other studies have shown POMS to be associated with both LOS and other pre-operative comorbidities [9-11].

However, to date the POMS has not been evaluated specifically in hip fracture patients. Its use and performance is likely to vary when applied to specific patient populations, reflected in the modification of the original POMS from a nine-domain item to the cardiac postoperative morbidity score (C-POMS, appendix1) [12] which is a 13-domain discharge score. The distinctive morbidity aspects and disparities across surgical specialities necessitate the need for a speciality specific POMS [7 12]. We hypothesise that patients undergoing fragility hip fracture surgery are most likely to express morbidity related to mobility, and pain aspects due to both mechanical injury and surgical trauma [13 14]. After hip fracture from a fall, there may be psychological implications, fear and anxiety about walking again. The aims of this study were to describe and quantify postoperative complications in the older hip fracture population, and develop and validate a hip fracture postoperative morbidity survey tool (HF–POMS).

Methods

A prospective clinical observational cohort study was conducted across three English National Health Service (NHS) Hospitals. Study recruitment commenced in April 2015 and ended on 31st July 2016. Ethical approval was received from the East Midlands – Northampton NRES Committee – study ethics number 15/EM/0054 and local NHS research and development permission was granted before study commencement. The study complied with Good Clinical Practice standards set forth in the Declaration of Helsinki of 1975 [15].

Patients were recruited from orthopaedic and trauma wards following surgery. Inclusion criteria were: male or female; ≥ 70 years old; emergency admission with primary fracture of the hip and able to gain written informed consent from the patient or personal consultee. Initial recruitment (n = 100) was solely patients able to consent for themselves. Following study amendment, the final 241 participants included both those unable to give their own consent and those who could provide consent. Exclusion criteria were: terminal illness, pathological fracture, in-hospital fractures, and patients enrolled in a medicinal product interventional trial.

Study items of interest and criteria definitions were initially identified from both the original POMS [5 7] and C-POMS [12]. A literature search, to identify any additional commonly observed complications after hip fracture surgery was performed. A draft list of potential additional and amended items was circulated to six orthogeriatricians for their views, comments and addition of items they considered important from clinical experience.

Three steps were taken to identify redundant items, a) a pairwise correlation matrix of all items on the data collection form was performed, b) item prevalence within the study population and c) all new identified items were sent to a team of orthogeriatricians for comments on item clinical severity, importance and the likelihood of currently being captured by the POMS [7].

Items with a correlation of > 0.8 were excluded. Using feedback and comments from the specialty team, items for inclusion had to meet three of the following criteria:

(i) The identified morbidity item prevalence must be ≥ 5%

(ii) Whether the morbidity item identified is likely to be captured by the original POMS or otherwise. The likelihood was measured using a 5-point Likert scale with threshold for inclusion set as median < 3 (i.e. unlikely to be captured)

(iii) The likelihood that the patient remains in acute care due to this morbidity item. Scored on a 5-point Likert scale. Threshold for inclusion was set as median ≥3.5 (i.e. likely to be associated with remaining in acute care)

(iv) Severity of the morbidity item in explaining post-operative morbidity requiring clinical management. Scored on a 5-point Likert scale. Threshold for inclusion set as median ≥3.5 (i.e. likely to require clinical management)

Each item was further reviewed by the research team and final items for inclusion agreed by discussion.

Participants were followed up on days 1, 3, 5, 8 and 15 post-surgery during their hospital stay at the primary admission hospital, documenting presence or absence of morbidities according to the defined criteria. Data were gathered from various sources (patient notes, treatment charts, biochemistry results, patient questioning and patient observation). Perioperative risk was estimated using the Nottingham Hip Fracture Score (NHFS) [16 17] and the American Society of Anaesthesiology physical assessment (ASA) [18 19]. Mobility was measured using a modified Cumulated Ambulation Score (CAS) [20]. Length of stay was defined as the difference in days between the date of discharge from the acute orthopaedic ward and the date of admission in the index episode. Data were coded and collated into a Microsoft Access database.

Statistical analysis

Descriptive statistics were used for demographic data and summary results of the pre-operative comorbidities. We categorized duration of hospital stay variable by study site and age. Multivariate logistic regression was used to determine the independent association between LOS and individual HF-POMS domains. Internal consistency was measured using Cronbach alpha for validity and reliability [21]. Cross-data collection validation (inter-rater reliability) was measured using Cohen's Kappa [22]. Chi-squared test was used to compare risk of morbidity in general surgery patients and hip fracture patients. Results were considered significant with p values <0.05 and all p values were two sided. All calculations were performed using R statistical package [23].

Results

A total of 647 patients were screened and 347 recruited into the study. Six patients were withdrawn on review, not meeting the inclusion criteria, leaving 341 patients for final analysis. The observed in-hospital mortality rate was 2.4%. Seventy-four (21.7%) of the participants were male and 267 (78.3%) female. Mean age was, 83.5 [range 70 - 108]. Two hundred and four (59%) had an ASA score of III, IV and V combined. The NHFS median score (IQR [range]) was 4.0 (4.0, 5.0 [3.0-9.0]). Mean (SD) LOS was 16.9 (11.2) days [range 4-87]. We observed a variation in mean LOS across study sites (UHL 12.9 days, NUH 17.4 days, and STH 26.5 days) and across age groups (70-79 years 14.1 days, 80-89 years 16.5 days and ≥90 years 21.7days). Arthroplasty was performed in 175 patients (51.3%) and hip screws in 164 (48.7%). Three hundred and three (89%) of the patients were admitted from their own home with 38 (11%) admitted from residential institutions. One hundred and eighty-eight (55.1%) were discharged to their own homes, 86 (25%) to rehabilitation / community hospitals while 59 (17.3%) went to long-term institutions. All participants (n = 341) were inpatients on days 1 and 3, reducing thereafter (day 5, n = 329; day 8, n = 303; day 15 n = 167).

Table1 Descriptive characteristics of patients included in the study.

HF-POMS development

In addition to the original POMS items, 19 new morbidity items were identified. Six items had a prevalence of <5%; all new items were observed to have a low likelihood to be captured by the original POMS. Thirteen items where considered to have a high likelihood of influencing patient stay in hospital and eight of all new items were considered to be highly important in describing and quantifying post-operative complications requiring clinical management after hip fracture surgery. Assisted ambulation (mobility) and psychological domains new items were therefore included, and pain domain criteria definition modified.

Each of the original POMS domains had a prevalence ≥ 5% except the wound and pain (as defined in POMS) domains with observed prevalence of 1.5% and 1% respectively. Parenteral opioids use is the key criteria definition of the pain domain in POMS, however after hip fracture surgery intravenous opioid use is generally avoided accounting for the low observed rates of this domain in this study. Similarly, wound complication rates are known to be low following hip fracture surgery.

Thirteen items met the inclusion criteria requirements and were therefore included in the final proposed HF-POMS, with twelve morbidity domains. Within the new pain domain criteria definition, oral opioids specifically relate to oral morphine and oxycodone as required (PRN) for pain related to surgery, excluding codeine phosphate and dihydrocodeine.

Table 2 HF–POMS domains and definition criteria

Reliability and Construct validity

Internal consistency was measured using Cronbach's alpha. Overall raw alpha value was 0.54 (95% CI 0.47 - 0.60) and for individual postoperative days alpha values were low-moderate; day 1 = 0.38, day 3 = 0.42, day 5 = 0.47, day 8 = 0.47 and day 15 = 0.63. Inter-observer variation measurement showed substantial agreement (kappa 0.68, $p = 0.001$).

Patients with higher perioperative risk scores (NHFS > 4 and those with ASA grades III-V) developed more HF–POMS defined morbidities (appendix 2) and had increased subsequent LOS. Any increase in NHFS and ASA predicted an increase in LOS by 2.0 days (95% CI 0.5 – 3.5, $p = 0.008$) and 2.5 days (95% CI 0.6 – 4.5, $p = 0.012$) respectively.

Prevalence of HF-POMS

Overall HF-POMS observed morbidities decreased by postoperative day (Figure 1, Table 3). The five domains with highest prevalence were assisted ambulation, renal, pain and infectious. Ambulation assistance ranged from 98% – 58% present on days 1, 3 and 5, renal 81% – 46%, pain 62% – 31% and infectious 58% – 9% during the same period. Moderately high morbidity levels were observed in the gastrointestinal, cardiovascular and neurological domains and low levels in the psychological, wound, endocrinology, haematology and pulmonary domains. The proportion of patients remaining in hospital without HF-POMS morbidity increased with time: 19% on day 5, 38% day 8, 58% day 15. By day 15, 51% of patients were discharged from hospital.

Using data from the Middlesex postoperative morbidity survey study [24], we compared the prevalence of common morbidity domains in our study population (after domain criteria definition modification for HF-POMS) to general surgery inpatients on postoperative days 5, 8 and 15 (Figure 2). The pattern of high prevalence morbidity varied significantly (day 5 $p<0.013$, day 8 $p<0.001$ and day 15 $p<0.001$; Chi-squared) between general surgery (gastrointestinal, infectious, wound, and pulmonary) and hip fracture patients (mobility, renal, pain, and infectious). Variation in morbidity prevalence between the two cohorts were statistically significant ($p<0.038$) in almost all morbidity domains across the three postoperative days.

Table 3 Summary of HF–POMS morbidity rates

Figure 1 HF-POMS daily morbidity

Figure 2 Morbidity Prevalence: Comparison of common HF-POMS (above) and POMS (below) domain prevalence between hip fracture patients (n=341) and general surgery patients (n= 439), from the Middlesex postoperative survey study [24]

Predictive ability of HF-POMS

Presence of any HF-POMS morbidity compared to absence of morbidity on day 8 and 15 was associated with an increase in subsequent LOS by 3.1 days (95% CI 0.9 – 5.3, p= 0.005) and 15.8 days (95% CI 13.4 – 18.3, p = 0.001) respectively. The renal domain was observed to be an independent predictor of LOS across all HF–POMS days and assisted ambulation in all other days except day 1.

Figure 3 Adjusted Length of stay by morbidity domain per HF-POMS day.

Other reasons identified for staying in hospitals

Social reasons (appendix 3) are additional to non-medical reasons for why some of the patients remained in hospital.

Discussion

Our study results support the development of a hip fracture specific POMS. The pattern of morbidity following hip fracture is clinically different to the original POMS: HF-POMS demonstrates the expected relationships with time, known predictors of risk and presence of HF-POMS is predictive of prolonged length of stay. In common with previous work, and patient and clinical experience, a significant number of patients remain in acute hospital care following fracture without overt medical reason.

The 2.4% in-hospital mortality rate is in line with previous studies [25] and the average LOS of 16.9 days similar to the national average [1]. The overall studied population was biased slightly towards a fitter group, due to the initial recruitment of participants with capacity only. There are differences in local practice around acute hospital discharge between the three units, reflected in the differing lengths of stay.

Higher risk patients have greater morbidity [19] and in turn, morbidity is predictive of subsequent length of stay [26]. The HF-POMS has face validity as it has been developed solely from emergency hip fracture patients and morbidity domains identified are commonly known hip fracture complications [27] known to associate with LOS [28-30].

Studies that validated the original POMS [3 6-8] in various surgeries have shown that individual POMS domains can predict LOS. The domain associated with greatest increase in length of stay (endocrine) was relatively infrequent (6%) and so is probably less clinically relevant. In contrast, impaired mobility has the greatest overall impact – with a large proportion of patients, and a moderate increase in LOS.

Grocott and colleagues [7] found that orthopaedic patients were less likely to have POMS defined morbidity. For similar domains in POMS, our study participants have exhibited a high presence of pain (14% – 62%), renal (14% – 81%) and infectious (7% – 58%) morbidity. There are several reasons to be considered for these differences. First, all patients considered in our study are emergency admissions requiring urgent surgery compared to the previous study [7] where major elective surgery patients were enrolled. Secondly, age difference; we recruited patients aged ≥70 years compared to ≥18 years in the original studies. Older age has been associated with high risk of perioperative morbidity, mortality and increased LOS [2 10]. This has also been observed by Howes and colleagues [3] in their study validating POMS in emergency laparotomy patients.

POMS has already been developed for use in a specific patient population [12] and our work builds on this approach. Some morbidity domains are strongly influenced by type of surgery – hence the differential rate of gastrointestinal morbidity between general surgical and hip fracture patients. In comparison to the POMS with nine morbidity categories, the HF-POMS has twelve morbidity domain categories with psychological, assistant mobilisation and endocrinology domains added. We made a conscious decision to change the pain criteria. Hip fracture is painful but intravenous opioids are not routinely used in the hip fracture population.

An assisted ambulation domain was developed to account for new or escalated postoperative requirement for mobility assistance with two people and walking aid(s). Endocrine-metabolic complications in hip fracture population have previously been reported in 30% of patients [27] although lower rates were observed in this study.

A new psychological domain has been included. The prevalence and ramifications of fear of falling causing anxiety after hip fracture surgery are well-documented [31]. Two separate studies reported fear of falling ranging from 21%-85% [32] and 60% at four weeks and 47% at 12 weeks [33] after hip fracture. These factors do not influence LOS during the early post-operative period, however if still present by day 15 are associated with longer LOS. Hospital discharge is potentially delayed in those with anxiety of falling as they restrict their activities in an effort to reduce the risk.

A few study limitations were observed in this study. Our age inclusion criterion was 70 years and above which could limit generalisation of the results to patient below this age; this is a small proportion of patients with hip fracture. Seventy-one percent of participants from one of the study sites (UHL) had their NHFS missing as the data is not routinely collected. Low-moderate internal consistency was observed among the morbidity domains suggesting that the tool might not be suitable to be used as a summary score reflecting the views of Grocott [7]. The increased serum creatinine levels as defined by the HF-POMS were observed in a very low number of participants (only 1%). This could have been due to the limited access to biochemistry results available for the study team. Furthermore, such blood tests are not a daily routine. Additionally, although minor degrees of acute kidney injury are a risk factor for poorer outcome, it is asymptomatic and seem unlikely to be a cause for staying in acute care *per se* [34].

Data for HF–POMS were collected from three NHS sites and inter-rater reliability was good reflecting its potential for nationwide application. All research sites were acute care trusts and morbidity was measured during hospital stay. As a standard discharge guide framework, HF-POMS could be used to categorise patients at different levels within the discharge pathway improving early discharge particularly with the current bed pressures in the NHS. Moreover, this might determine discharge destination, whether the patient will be transferred from acute care to a community hospital, intermediate care or residential home for further rehabilitation or they will be discharged back to their own home.

The HF–POMS does not address non-medical aspects affecting prolonged hospital stay. Several non-morbidity factors have been identified keeping the patients in hospital [7 12]. In this study we observed 8% remained in hospital for social reasons only on day 15.

In the light of the validation provided by this study we believe that HF-POMS has potential value for local quality improvement and audit, commissioning and research. At an immediate practical level, it may assist members of the hip fracture care pathway in discussing and making discharge plans. We have described the variation in morbidity factors at different stages post-surgery. High morbidity scores at any post-operative point are associated with a longer length of stay.

References

1. National Hip Fracture Database (NHFD) annual report 2018. Falls and Fragility Fracture Audit Programme (FFFAP). Available from https://www.nhfd.co.uk/2018report [Accessed 4 March 2019]
2. Smith PAC, Bardsley M. Focus on hip fracture: Trends in emergency admissions for fractured neck of femur, 2001 to 2011. The Health Foundation and the Nuffield Trust, 2013. Available from https://www.health.org.uk/publications/qualitywatch-focus-on-hip-fracture [Accessed 4 March 2019]
3. Howes TE, Cook TM, Corrigan LJ, Dalton SJ, Richards SK, Peden CJ. Postoperative morbidity survey, mortality and length of stay following emergency laparotomy. *Anaesthesia* 2015; **70**: 1020-7.
4. Moonesinghe S, Harris S, Mythen M, Rowan K, Haddad F, Emberton M, et al. Survival after postoperative morbidity: a longitudinal observational cohort study. *Br J Anaesth* 2014; **113**: 977-84.
5. Bennett-Guerrero E, Welsby I, Dunn TJ, Young LR, Wahl TA, Diers TL, et al. The use of a postoperative morbidity survey to evaluate patients with prolonged hospitalization after routine, moderate-risk, elective surgery. *Anesth Analg* 1999; **89**: 514-9.
6. Davies SJ, Francis J, Dilley J, Wilson RJT, Howell SJ, Allgar V. Measuring outcomes after major abdominal surgery during hospitalization: reliability and validity of the Postoperative Morbidity Survey. *Perioper Med* 2013; **2**: 1-9.
7. Grocott MP, Browne JP, Van der Meulen J, et al. The Postoperative Morbidity Survey was validated and used to describe morbidity after major surgery. *J Clin Epidemiol* 2007; **60**: 919-28.

8. Goodman BA, Batterham AM, Kothmann E, Cawthorn L, Yates D, Melsom H, et al. Validity of the Postoperative Morbidity Survey after abdominal aortic aneurysm repair—a prospective observational study. *Perioper Med* 2015; **4**: 1-9.
9. Ackland GL, Harris S, Ziabari Y, Grocott M, Mythen M. Revised cardiac risk index and postoperative morbidity after elective orthopaedic surgery: a prospective cohort study. *Br J Anaesth* 2010; **105**: 744-52.
10. Ackland GL, Moran N, Cone S, Grocott MP, Mythen MG. Chronic kidney disease and postoperative morbidity after elective orthopedic surgery. *Anesth Analg* 2011; **112**: 1375-81.
11. Ackland GL, Scollay JM, Parks RW, de Beaux I, Mythen MG. Pre-operative high sensitivity C-reactive protein and postoperative outcome in patients undergoing elective orthopaedic surgery. *Anaesthesia* 2007; **62**: 888-94.
12. Sanders J, Keogh BE, Van der Meulen J, Browne JP, Treasure T, Mythen MG, et al. The development of a postoperative morbidity score to assess total morbidity burden after cardiac surgery. *J Clin Epidemiol* 2012; **65**: 423-33.
13. British Orthopaedic Association (BOA). The Care of Patients with Fragility Fracture, 2007. Available from http://www.bgs.org.uk/pdf_cms/pubs/Blue%20Book%20on%20fragility%20fracture%20care.pdf [Accessed 4 March 2019].
14. Parker M, Johansen A. Hip fracture. *BMJ* 2006; **333**: 27-30.
15. World Health Organisation (WHO) Guidelines for good clinical practice (GCP) for trials on pharmaceutical products. WHO Technical Report Series, 1995. Available from http://apps.who.int/medicinedocs/pdf/whozip13e/whozip13e.pdf [Accessed 4 March 2019].

16. Moppett I, Parker M, Griffiths R, Bowers T, White S, Moran C. Nottingham Hip Fracture Score: longitudinal and multi-centre assessment. *Br J Anaesth* 2012; **109**: 546-50.

17. Marufu TC, Mannings A, Moppett IK. Risk scoring models for predicting peri-operative morbidity and mortality in people with fragility hip fractures: Qualitative systematic review. *Injury* 2015; **46**: 2325-34.

18. Cullen DJ, Apolone G, Greenfield S, Guadagnoli E, Cleary P. ASA Physical Status and age predict morbidity after three surgical procedures. *Ann Surg* 1994; **220**: 3-9.

19. Johansen A, Tsang C, Boulton C, Wakeman R, Moppett I. Understanding mortality rates after hip fracture repair using ASA physical status in the National Hip Fracture Database. *Anaesthesia* 2017; **72**: 961-966.

20. Kristensen MT, Jakobsen TL, Nielsen JW, Jørgensen LM, Nienhuis R-J, Jønsson LR. Cumulated Ambulation Score to evaluate mobility is feasible in geriatric patients and in patients with hip fracture. *Dan Med J* 2012; **59**: A4464.

21. Sijtsma K, On the use, the misuse, and the very limited usefulness of Cronbach's alpha. *Psychometrika* 2009; **74**: 107-120.

22. Viera AJ, Garrett JM. Understanding interobserver agreement: the kappa statistic. *Fam Med* 2005; **37**: 360-3.

23. The R Project for Statistical Computing 2016. Available from http://www.r-project.org/ [Accessed 4 March 2019].

24. Grocott M. Measuring Morbidity following Major Surgery 2010. Available from http://discovery.ucl.ac.uk/19679/3/19679.pdf [Accessed 4 March 2019].

25. Foster KW. Hip fractures in adults, 2016. Available from http://www.uptodate.com/contents/hip-fractures-in-adults [Accessed 4 March 2019].

26. Moppett IK, Wiles MD, Moran CG, Sahota O. The Nottingham Hip Fracture Score as a predictor of early discharge following fractured neck of femur. *Age Ageing* 2012; **41**: 322-26.

27. Carpintero P, Caeiro JR, Carpintero R, Morales A, Silva S, Mesa M. Complications of hip fractures: A review. *World J Orthop* 2014; **5**: 402-11.

28. Lefaivre KA, Macadam SA, Davidson DJ, Gandhi R, Chan H, Broekhuyse HM. Length of stay, mortality, morbidity and delay to surgery in hip fractures. *J Bone Joint Surg Br* 2009; **91**: 922-7.

29. Foss NB, Palm H, Krasheninnikoff M, Kehlet H, Gebuhr P. Impact of surgical complications on length of stay after hip fracture surgery. *Injury* 2007; **38**: 780-4.

30. Ireland, A.W., P.J. Kelly, and R.G. Cumming, Total hospital stay for hip fracture: measuring the variations due to pre-fracture residence, rehabilitation, complications and comorbidities. *BMC Health Services Research* 2015; **15**:17.

31. Price SA. A qualitative study of the impact of hip fracture in the elderly population, 2000. Available from http://ro.ecu.edu.au/theses/1367 [Accessed 4 March 2019].

32. Scheffer AC, Schuurmans MJ, van Dijk N, van der Hooft T, de Rooij SE. Fear of falling: measurement strategy, prevalence, risk factors and consequences among older persons. *Age Ageing* 2008; **37**: 19-24.

33. Bower ES, Wetherell JL, Petkus AJ, Rawson KS, Lenze EJ. Fear of Falling after Hip Fracture: Prevalence, Course, and Relationship with One-Year Functional Recovery. *Am J Geriatr Psychiatry* 2016; **24**: 1228-36.

34. Porter CJ, Moppett IK, Juurlink I, Nightingale J, Moran CG, Devonald MAJ. Acute and chronic kidney disease in elderly patients with hip fracture: prevalence, risk factors and outcome with development and validation of a risk prediction model for acute kidney injury. *BMC Nephrology* **2017**; 18: 1-11.

Tables and Figures legends

Table 1: Baseline characteristics of patients included in the study (n=341)

Table 2: Hip Fracture Postoperative Morbidity Score (HF-POMS): domains and criteria definition

Table 3: Total Morbidity Present, n (%)

Figure 1: HF-POMS daily morbidity

Figure 2: Comparison of common HF-POMS (above) and POMS (Middlesex) (below) domains prevalence between hip fracture patients (n=341) and general surgery patients (n= 439), from the Middlesex postoperative survey study [24]

Figure 3: Adjusted increase in LOS by morbidity domain per HF-POMS day