Mini-review

Preliminary results of an early vs delayed timing of surgery in the management of proximal femur fragility fractures

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Summary

Introduction. The appropriate surgical timing for the treatment of proximal femur fractures is still debated. Advantages of a delayed surgery may be: stabilization of systemic diseases, decrease of the risk of perioperative mortality and morbidity. An early timing of surgery may allow: early mobilization, reduction of the risks of disability and hospital stays, early return to home of the patients. However, the effects on mortality are still discussed.

Purpose. The purpose of this study is to assess the influence of the surgical timing on clinical outcomes, complications, and mortality in a preliminary experience of the early management of these fractures vs the delayed surgery.

Methods. A series of 176 patients was retrospectively evaluated. 132 patients were followed-up for one year after surgery. The evaluation was performed by the assessment of the comorbidities, preoperative wait for surgery, type of fracture and procedures, hospital stay, and functional outcomes: 33 patients were operated with an early timing, 99 with a delayed surgery.

Results. The mean mortality rate was 18.2% in the early timing (6/33 patients), and 23.2% in the delayed timing (23/99 patients): no significant difference was recorded in the preliminary analysis. Postoperative complications were recorded in 28 patients (21.2%): 4 patients were operated within 48 hours (12.1%) and 24 after 48 hours (24.2%) with no substantial differences. The postoperative hospital stay showed no correlation with the timing of surgery, as no evidence was found on the functional recovery and postoperative disability.

Conclusions. No significant differences were found on the evaluated parameters in the two groups in the present preliminary study. A correlation between male sex and mortality, and male sex and postoperative complications was assessed. An enlargement of the study population is needed to surely clarify any effective differences, given the fact that recent studies seem to identify in the early treatment the better strategy to ensure the best recovery and the lower rate of mortality and complications.

KEY WORDS: timing of surgery; proximal femur fractures.

Introduction

The most appropriate surgical timing for the treatment of fragility fractures of proximal femur is still a matter of debate, even if they represent the most common fractures worldwide (1). There are conflicting opinions about the most appropriate timing of surgery in order to achieve the best functional outcomes with the lower rate of clinical risks, optimizing at the same time the economic resources. Theoretical advantages of a delayed surgery is to allow a stabilization of any systemic disease and to correct medical imbalances, decreasing perioperative risks of mortality and morbidity. On the other hand, the possible adverse effects are an increased incidence of postoperative complications, longer hospital stays, a slow functional recovery, and a possible impact on mortality (2). An early timing of surgery (surgery not over 48 hours after the fracture) may allow an early mobilization of the patients, reducing the risks of disability and hospitalization, finally enabling an early return to home. Moreover, it may allow a reduction of the use of pain controlling drugs, often a further cause of imbalance. However, the effects on mortality rates are still now debated (3, 4). All this is part of the so-called “framework of frail elderly”, increasingly requiring a global “orthogeriatric approach”, as widely discussed (5).

The purpose of this preliminary retrospective study is to assess the influence of the surgical timing on the management of proximal femur fractures at a single institution by the analysis of specific objectives as clinical outcomes, rate of complications, mortality at one year after surgery, perioperative morbidity, time of postoperative hospital stay, onset of any disabilities, and the patients’ loss of autonomy.

Methods

A series of 176 patients undergoing surgical procedures for proximal femur fracture at the authors’ Institution in a period between January 2007 and December 2008 was retrospectively evaluated. All the procedures followed the principles of the Declaration of Helsinki. Exclusion criteria were: patients with less than 65 years of age at the time of the fracture,
concomitant major trauma, associated fracture of the pelvis, previous fracture or surgery on the same femur, bilateral hip fracture, pathological fracture. Forty-four patients were lost at follow-up or did not attend to the outpatient visits. No dedicated teams and no specific protocols of management were adopted unless the timing of surgery.

The final study population resulted of 132 patients. Twenty-nine were males (22%), and 103 females (78%), with a mean age of 83.6 years at the time of fracture (range: 65-99 years). The demographic data are summarized in Table 1.

All clinical data were obtained evaluating the medical records, collecting demographic details, type of surgery and implants, intraoperative parameters, complications, days of hospitalization, and date of discharge.

Comorbidities
We considered the presence of comorbidities such as dementia, arterial hypertension, diabetes mellitus, stroke, heart or vascular disease, treatment with anticoagulant drugs, liver disease, kidney disease, chronic obstructive bronchopathy, malignant tumours at the time of the fracture. Any significant alteration in blood tests was also assessed by standard blood exams at the time of admission. The American Society of Anesthesiologists (ASA) score was used for the classification of the comorbidities in all selected patients (6).

Preoperative period
The mean interval from the day of admission to the surgery was 5.2 days (range: 1-19 days). We divided the subjects into two groups: patients undergoing surgery within 48 hours after admission (early timing), and patients operated after 48 hours (delayed timing). A delayed timing was determined for the previous hospital organization, while an early management has recently been introduced at the authors’ Institution given the encouraging results reported in the last years.

Type of fracture and surgery
We divided the femoral fractures in the classical manner, as medial or lateral. Different strategies of treatment are historically chosen depending on the pattern of fractures (7). All surgical records were analyzed to assess the type of fixation or prosthetic treatment performed.

Hospitalization and complications
All data concerning the hospital stay and postoperative complications were recorded: death, major cardiac or pulmonary complications, deep vein thrombosis, urinary tract complications, decubitus ulcers, blood loss, surgical wound infections, and mechanical complications related to the implants.

Postoperative functional ability
All patients were followed-up at the outpatient office at 3, 6 and 12 months after surgery. The patients or their relatives were also contacted by phone interviews after more than one year, obtaining data on the eventual cause of death within a year after surgery, the patient’s residence after discharge from the hospital, prefracture and postsurgical Barthel index (8), in order to assess the disability resulting from the fracture and the subsequent loss of autonomy. The self-autonomy capabilities of the patients or their residence before and after surgery were also classified into 5 categories: at home and self-sufficient, at home and not self-sufficient, at home with caregivers, long-term care facility, and hospital ward (Table 2).

Statistic analysis
The statistical analysis was performed with the software Stata 7.0 (StataCorp LP, Texas, USA), elaborating frequency tables for the description of the sample and contingency tables to compare the frequency of outcomes in the groups. A Student’s t-test was applied to compare quantitative or continuous variables. The chi-squared or Pearson test was applied.
to compare qualitative or dichotomous variables. The dependence technique of univariate logistic regression Stepwise was used to highlight a dependency between the dependent and the independent variable, and then to identify the possible confounding factors. Finally, all the objectives of the study have also been studied with Stepwise multivariate analysis with logistic regression for binary qualitative variables and with linear regression for ordinal quantitative variables.

Results

Most of the patients (54.55%) presented 0 to 2 comorbidities (ASA score 0, 1, or 2) and 45.45% more than 2 comorbidities (ASA 3 or 4) (Table 3). The early timing group consisted of 33 patients (25.0%), while the delayed timing group consisted of 99 patients (75.0%). Regarding the type of fractures, 68 patients were affected by a medial fracture (51.5%). Nine were treated by a closed reduction and internal fixation by cannulated screws (6.82%), 40 by a hemiarthroplasty of the hip (30.3%), and 19 by a total hip replacement (14.3%). Sixty-four patients presented a lateral fracture (48.5%). Thirty-six were treated by an intramedullary nailing (27.27%), and 28 by a sliding hip screw (21.21%) (Table 4). In the majority of cases a locoregional anaesthesia was chosen (95.5%); only in 6 patients a general anaesthesia was performed (4.5%).

Mortality rate at 1 year after surgery

Twenty-nine patients out of 132 (21.9%) died, 9 of which (6.8%) during the hospitalization. Mortality at one year was observed in the group with early timing with a value of 18.2% (6 deaths out of 33 subjects); in the group with delayed timing mortality reached up a value of 23.2% (23 deaths out of 99 patients). No statistically significant difference was found by the analysis with the Pearson test (Table 5), indicating no influence of the surgical timing on the mortality at one year after surgery. The univariate analysis was corrected to highlight the variables affecting the mortality rate or predicting an increased risk of death, setting them in the multivariate analysis with a logistic regression. The evaluation regarded: age, sex, comorbidities, timing, type of fracture, and the rates of complications. Also after this evaluation the surgical timing was not considered crucial for determining the mortality at one year after surgery (Table 6). On the other hand, male sex and the rate of complications were strongly correlated with an increased risk of mortality, and therefore considered negative predictive factors of the survival at one year after surgery.

Early postoperative complications

Postoperative complications occurred in 28 patients (21.2%): in 19 subjects a single complication was recorded; in 8 patients 2 complications occurred, and in 1 patient 3 complications were recorded. The most frequent complication was mortality (9 patients, 6.8%), followed by cardiovascular complications (8 patients, 6%), and deep venous thrombosis (6 patients, 4.5%). Other complications were implant dislocations (3.8%), ulcers (3%), pulmonary complications (2.3%), urinary complications (0.8%), and superficial infection of the surgical scars (0.8%). Among the 28 patients with postoperative complications, 4 were operated within 48 hours (12.1%) and 24 after 48 hours (24.2%) (Table 7). The ASA score directly corre-

Table 3 - Comorbidities founded on the study population.

<table>
<thead>
<tr>
<th>N° comorb</th>
<th>N°patients</th>
<th>%</th>
<th>Cum.</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>17</td>
<td>12.88</td>
<td>12.88</td>
</tr>
<tr>
<td>1</td>
<td>23</td>
<td>17.42</td>
<td>30.30</td>
</tr>
<tr>
<td>2</td>
<td>32</td>
<td>24.24</td>
<td>54.55</td>
</tr>
<tr>
<td>3</td>
<td>33</td>
<td>25.00</td>
<td>79.55</td>
</tr>
<tr>
<td>4</td>
<td>15</td>
<td>11.36</td>
<td>90.91</td>
</tr>
<tr>
<td>5</td>
<td>7</td>
<td>5.3</td>
<td>96.21</td>
</tr>
<tr>
<td>6</td>
<td>4</td>
<td>3.3</td>
<td>99.24</td>
</tr>
<tr>
<td>8</td>
<td>1</td>
<td>0.76</td>
<td>100.00</td>
</tr>
<tr>
<td>Total</td>
<td>132</td>
<td></td>
<td>100.00</td>
</tr>
</tbody>
</table>

Table 4 - Type of surgical procedures.

<table>
<thead>
<tr>
<th>Type of intervention</th>
<th>Freq.</th>
<th>Percent</th>
<th>Cum.</th>
</tr>
</thead>
<tbody>
<tr>
<td>THA</td>
<td>19</td>
<td>14.39</td>
<td>14.39</td>
</tr>
<tr>
<td>Hemiarthroplasty</td>
<td>40</td>
<td>30.30</td>
<td>44.70</td>
</tr>
<tr>
<td>Screws</td>
<td>9</td>
<td>6.82</td>
<td>51.52</td>
</tr>
<tr>
<td>Plate</td>
<td>28</td>
<td>21.21</td>
<td>72.73</td>
</tr>
<tr>
<td>I.M. Nail</td>
<td>36</td>
<td>27.27</td>
<td>100.00</td>
</tr>
<tr>
<td>Total</td>
<td>132</td>
<td></td>
<td>100.00</td>
</tr>
</tbody>
</table>

Table 5 - Assessment of the rate of mortality related to the surgical timing.

<table>
<thead>
<tr>
<th>Timing</th>
<th>Death in the first year</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>no</td>
</tr>
<tr>
<td>&lt;48hrs</td>
<td>27</td>
</tr>
<tr>
<td></td>
<td>81.82</td>
</tr>
<tr>
<td>&gt;48hrs</td>
<td>76</td>
</tr>
<tr>
<td></td>
<td>76.77</td>
</tr>
<tr>
<td>Total</td>
<td>103</td>
</tr>
<tr>
<td></td>
<td>78.03</td>
</tr>
</tbody>
</table>

Table 6 - Assessment of the risk of 1-year mortality related to the surgical timing.

<table>
<thead>
<tr>
<th>Death in the first year</th>
<th>Odds ratio</th>
<th>P&gt;z</th>
<th>Confidence interval (95%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>1.058</td>
<td>0.075</td>
<td>.9943 1.126</td>
</tr>
<tr>
<td>Gender</td>
<td>.3167</td>
<td>0.037</td>
<td>.1075 .9323</td>
</tr>
<tr>
<td>Comorbidities</td>
<td>1.889</td>
<td>0.199</td>
<td>.7158 4.987</td>
</tr>
<tr>
<td>Timing</td>
<td>.8762</td>
<td>0.826</td>
<td>.2707 2.836</td>
</tr>
<tr>
<td>Type of fracture</td>
<td>.8192</td>
<td>0.687</td>
<td>.3106 2.1608</td>
</tr>
<tr>
<td>Postop complications</td>
<td>6.750</td>
<td>0.000</td>
<td>2.444 18.636</td>
</tr>
</tbody>
</table>

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related to the onset of complications in both groups. The Pearson test showed no association between the development of postoperative complications and surgical delay. Also performing a multivariate analysis with a logistic regression it was confirmed the lack of correlation between the occurrence of postoperative morbidity and surgical timing (Table 8). On the other hand, this analysis showed the existence of a statistically significant correlation between the presence of preoperative comorbidity and the development of complications after surgery. Variables such as age and type of fracture showed no correlations with the occurrence of postoperative complications.

Hospitalization
The mean postoperative hospital stay was 11.8 days (range 1-35 days), with 13.0 days for the group with early timing and 11.4 days for the delayed timing. The comparison between mean values and standard deviations of the two groups was not statistically significant at the T-test (Table 9). Also the Wilcoxon signed-rank test reported similar results, reinforcing the hypothesis that the postoperative hospital stay did not vary according to the timing of surgical treatment.

Discussion
Proximal femur fractures are the most common injuries worldwide in the elderly people (1, 4, 7, 9). Any study dealing with this frequent clinical issue may be considered crucial, given the significant impact on patients and society. Particularly, the analysis of the factors influencing the functional outcomes is important to improve the treatment. One of the most debated factors is surely the surgical timing. Several studies have been published in literature during the last decades with rather discordant results. Despite all the researches and studies, differing for methodologies and type of evaluations, there are still controversies about the influence of surgical timing in the postoperative results. Moreover, randomized studies with large number of patients, even if theoretically decisive, are impractical due to ethical reasons. One of the most important metaanalyses has been reported by Khan et al., considering the results of 52 prospective and retrospective studies: a clear discrepancy was assessed related to different methodological factors and results (2). However, recent studies seem to identify in the early treatment the better strategy to ensure the best recovery and the lower rate of mortality and complications (10, 11). At the Authors’ Institution, the early treatment of proximal femur fractures in patients of all ages has been recently introduced, with respect to the delayed management conducted until few years ago. The need of proving preliminary outcomes of the new approach has lead the Authors to deeply analyze all the involved factors to ascertain the opportunity to switch from a delayed to an early surgery for these patients.

Table 7 - Postoperative complications.

<table>
<thead>
<tr>
<th>Timing</th>
<th>Postoperative complications</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>no</td>
<td>yes</td>
</tr>
<tr>
<td>&lt;48hrs</td>
<td>29</td>
<td>4</td>
</tr>
<tr>
<td>&gt;48hrs</td>
<td>75</td>
<td>24</td>
</tr>
<tr>
<td>Total</td>
<td>104</td>
<td>28</td>
</tr>
</tbody>
</table>
Early timing: reduction of the mortality rate

A large number of studies assesses the existence of a positive association between increased mortality at one year and delay of surgical treatment: some analyses focused by adequate statistical methods important topics (12-14). Zuckerman et al. performed a prospective study on 367 patients over 65 years of age and able to walk before the fracture, 73% of which operated within 2 days, the remainder (27%) after 48 hours. They observed a two-fold risk of death at one year for the surgical delay, verifying variables such as age, sex, and comorbidities as the crucial factors. Furthermore, the occurrence of postoperative complications resulted to be independent from the surgical timing (12).

Moran et al. in their prospective study performed on 2660 patients with hip fractures, reported an overall mortality rate of 9% at one month, 19% at three months, and 30% at one year. Healthy patients undergoing surgery within 24 hours showed a mortality rate of 8.7% at one month, whereas the group of subjects operated later but within four days presented a value of 7.3% with no significant difference. The patients operated after the fourth day showed a mortality rate of 10.7%, with a significant increase at three months and one year. As a result, the authors concluded as appropriate the early timing of surgery (13).

The prospective study by Elliott et al. performed on 1780 patients showed an increase in 1-year survival rate in patients operated within 24 hours. Prognostic factors increasing the risk of mortality have been considered the age, the male gender (30.1% one-year mortality for men compared to 19.5% for women), the presence of more than one comorbidity, specifically dementia, a poor Barthel index, and finally the delayed surgical treatment (14).

Villar et al. in a study performed on 145 women treated by hemiarthroplasty for femoral neck fractures, conclude that patients operated within 30 hours showed good results with respect to subjects operated after 57 hours (15).

Dorotka et al., in their study performed on 182 patients with hip fractures, 79 of which operated within 6 hours after admission and 103 after 6 hours, assessed how the surgical delay induced an increase in the mortality rate. The early timing group reported a low mortality rate at 6 months compared to the group with delayed timing (10.1 vs 21.4%). However, no correlation emerged between the surgical timing and the hospital stay, as the functional recovery and the postoperative morbidity (16).

An increase in mortality and hospital stay was also reported in other retrospective studies (15-18). Novack et al. in a retrospective study performed on 4633 patients showed a lower perioperative mortality at 1 month and 1 year after surgery in patients operated within 2 days compared to those operated after 4 days (respectively 2.9, 4, 17.4% vs 4.6, 6.1, 26.2%). From a multivariable analysis adjusted for morbidity, they concluded that the delay in surgical treatment showed a gradual effect on increasing mortality (17).

Bredahl et al. reported an increased mortality in patients operated after 12 hours only for femoral neck fracture, without any significant difference for trochanteric fractures: therefore they concluded that femoral neck fractures in elderly patients should be considered as a “surgical emergency” (18).

Fox et al. in their study evaluated 142 consecutive patients with proximal femoral fractures over a 1-year follow-up period. Functional ability, age, and sex were recorded along with timing of surgery, complications, length of admission, mortality, and housing requirements after discharge. Operative procedures were performed mostly by a surgical staff on nighttime emergency lists shared with other specialties. The mean hospital stay was 31 days. In-patient mortality was 37% in males and 5% in females. It was possible to predict a prolonged hospitalization in 84%, mortality in 84%, mobility on discharge in 92%, and the need for rehousing in 83% of patients (19).

Doruk et al. demonstrated the need of surgery within 5 days after trauma to achieve a longer survival and better quality of life, assessing the higher rates of mortality, length of hospital stay, and a worse functional recovery in the group with delayed timing (20).

This recommendation was also reported by Hamlet et al., given the increased postoperative morbidity and mortality related to a surgical delay in 168 patients: particularly, there was a significant difference in mortality among the patients treated within 24 hours (20%) with respect to those treated after the first 24 hours (50%) (21).

From the study of Bottle et al. performed on 129.552 patients, it appears that the short-term mortality was reduced in the group with early surgery (within 24 hours) only in healthy subjects: on the other hand, for subjects affected by comorbidities it was suggested a clinical stabilization before surgery (22).

Weller et al. assessed an increase in perioperative mortality with a prolonged surgical interval after the fracture in a retrospective analysis of 57.315 patients (23).

Rogers et al. showed that the surgery after more than 72 hours was associated with an increase in mortality, infective complications, prolonged postoperative hospital stay, and therefore higher social costs (24).

Finally, Gdalevich et al. reported a rise in mortality rates at one year for a delay over 48 hours with specific variables independently associated to an increased mortality, as male gender, dementia, timing for rehabilitation, and pre-existing comorbidities (25).

Early timing: increase of the mortality rate

Few are the studies supporting the hypothesis of an increase of the rates of mortality in case of an early timing increases mortality. The retrospective study of Kenzora et al. performed on 399 patients showed a significant increase in the 1-year mortality in the group of patients operated within 48 hours (34 vs 5.8% in the group operated after the second day but before the fifth day) (26).

Mullen and Mullen performed a prospective study on 400 patients, showing that the 1-year mortality for patients operated within 24 hours was higher compared to patients operated after 72 hours (88 vs. 0%). In the interval between 24 and 72 hours they found an intermediate mortality rate of 52% (27).

Early timing vs delayed timing

Franzino et al. performed a large study on 13,882 patients observing, after adjustment of the other variables with a multivariate analysis, an absence of association between the surgical delay (>48 hours) and perioperative mortality. Comorbidities, male gender, and age significantly increased the rate of mortality (28).

Also Davis et al. have highlighted the lack of correlation between surgical timing and morbidity, as the occurrence of pressure ulcers and respiratory infections was not influenced by the surgical timing as well as the loss of functional autonomy (29).
Grimes et al. analyzing a series of 8,383 patients with a mean follow-up of 18 years found no increased risk of long-term mortality in patients operated after 96 hours compared to others operated within 48 hours (30).

Orosz et al., in their prospective study on 1,178 patients found that an early timing (<24 hours) did not affect the overall mortality, the functional recovery, decreasing on the other hand the hospital stay and the morbidity at 1 year (31).

Siegmeth et al., analyzing a series of 3,628 patients with an age >60 years (3,454 patients operated within 48 hours, and 174 patients after 48 hours), obtained no significant effects on the mortality, after adjustment of the patients comorbidities before surgery. They however found a prolonged hospital stay (21.6 days with early surgery vs 36.5 days with delayed surgery) and a worse functional recovery (32).

Parker and Pryor analyzed a lack of association between surgical timing and mortality, as well as hospitalization. They however highlighted an increased morbidity due to a delayed surgery, especially on the incidence of pressure ulcers (33). Similar results on the lack of correlation between timing and mortality were found by Elder et al., Hamilton et al., Majumdar et al., and Kondo et al. even with differences in the increase of comorbidities rate (34-37).

A recent study of Yonezawa et al. showed that an early surgery (within 24 hours) did not result in any advantages in terms of perioperative mortality (5.6% for the early timing, 2.6% for the delayed time) and length of hospitalization compared to a delayed surgery. However, the functional recovery was better in the early operated patients (52% compared to 41%). Another interesting point was the increase of the mortality of unstable patients for the early timing group, related to specific variables as the advanced age (>85 years), the presence of dementia and systemic diseases, a lateral femoral fracture, and the loss of autonomy before fracture (38).

According to Kosy et al. an early surgery may increase the departmental productivity and a greater financial efficiency by reducing the length of hospitalization without increasing the mortality of patients 30 days after surgery (39).

Conclusions

Our study has several limitations. The lack of an assessment of the severity and the potential progression of the patients’ comorbidities, and the use of a phone interview may have affected the analysis of data. The numerical discrepancy of the groups may be a reason for the lack of differences between the two strategies in this preliminary setting. However, some interesting points have been highlighted in the modern treatment of these fractures.

The present study showed to date no significant differences on mortality in a series of patients undergoing surgery with two different timings. A correlation between the male sex and mortality rates and male sex and the onset of postoperative complications were assessed. The mean mortality rate within one year after surgery in both groups showed no correlation with respect to the timing, in line with the literature. We think that a setting of a dedicated team and specific protocols of management of proximal femur fractures are crucial more than a simple anticipation of the surgical timing to achieve better outcomes as recently reported in literature.

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References

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