Early Ambulation After Hip Fracture

Effects on Function and Mortality

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Background: Few studies have examined the relationship between inpatient bed rest and functional outcomes. We examined how immobility is associated with function and mortality in patients with hip fracture.

Methods: We conducted a prospective cohort study of 532 patients 50 years and older, who were treated with surgery after hip fracture in 4 hospitals in New York. We collected information from hospital visits, medical records, and interviews. “Days of immobility” was defined as days until the patient moved out of bed beyond a chair. Follow-up was obtained on function (using the Functional Independence Measure) at 2 and 6 months and on survival at 6 months.

Results: Patients with hip fracture experienced an average of 5.2 days of immobility. Compared with patients with a longer duration of immobility (i.e., at the 90th percentile) in adjusted analyses, patients at the 10th percentile of immobility had lower 6-month mortality (−5.4%; 95% confidence interval [CI], −10.9% to −1.0%) and better Functional Independence Measure score for locomotion (0.99 points; 95% CI, 0.3 to 1.7 points, with higher values indicating better function), but there was no significant difference in locomotion by 6 months (0.58 points; 95% CI, −0.3 to 1.4 points). The adverse association of immobility was strongest in patients using personal assistance or supervision with locomotion at baseline (difference in 6-month mortality between the 90th and 10th percentile of immobility was −17.1% [P = .004] for this group and only 1.2% [P = .38] for patients independent in locomotion at baseline).

Conclusion: In patients with hip fracture, delay in getting the patient out of bed is associated with poor function at 2 months and worsened 6-month survival.

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bility criteria, and 571 (87.8%) of those patients gave informed consent for the study. Additional information on the study has been previously reported. This analysis focused on the patients who were not completely dependent in walking and who were treated with surgery (n=532).

We collected information on the time of immobility, reasons that might explain the length of immobility (patient characteristics, unstable clinical problems on admission, fracture characteristics, type of surgery, delirium, and complications), and outcomes. Trained research associates enrolled patients and collected information on prefracture function, residential location, and history of dementia from patients or their proxies. Information on each patient's functional status for the 2 weeks prior to fracture was obtained by interview using items from the motor scale of the Functional Independence Measure (FIM), which includes 3 subscales of physical functioning: (1) locomotion (a 2-item subscale focusing on walking and climbing stairs), (2) self-care (a 6-item subscale of self-care activities including bathing and dressing), and (3) transferring (a 3-item subscale focusing on transfers from the bed, toilet, and tub). Each item was scored between 1 (for complete dependence) and 7 (for complete independence) using specific criteria. Use of long-term care services was categorized as either admission from a nursing home, paid help required to care for the patient at home, or paid help for the family or others. Each patient was seen 5 days per week in the hospital, and the medical record was reviewed to collect additional information on the hospital course. We collected information during hospital visits on hospital arrival time, date and time of surgery, patient mobility by day, patient ratings of pain, the presence of an indwelling urinary catheter, and the occurrence of complications.

For mobility, the research associates determined from medical records and discussions with staff whether the patient had been at bed rest only, out of bed to chair, or out of bed beyond a chair. Information on mobility was only obtained through the first 20 postoperative days or discharge, whichever occurred first. For those who were still in the hospital beyond 20 postoperative days (n=16), we also collected information on mobility on the day of discharge. We defined the total days of immobility as the sum of the time from arrival to surgery plus postoperative days to getting the patient out of bed beyond a chair. For patients who were discharged after their 20th postoperative day and had not been mobilized beyond a chair by that point (n=8), we assumed that they were not mobilized beyond a chair from postoperative day 21 until discharge. In our main analyses, we made the conservative assumption that patients who had not been mobilized beyond the chair by discharge were mobilized by the next day. We tested whether our results were sensitive to these assumptions by repeating the analyses assuming that these patients were not mobilized until 3 days after discharge.

To supplement information collected at enrollment and on daily visits, the medical record was reviewed at discharge. Information was collected on chronic medical conditions, fracture characteristics, type of procedure, type of anesthesia, and transfusions. Information was also collected on abnormal clinical findings (eg, abnormal electrolytes) that are commonly available and used by clinicians to decide whether to delay surgery. From the combination of interview and medical record data available to the authors, we identified 4 potentially modifiable care processes (pain management, type of anesthesia, postoperative transfusion, and indwelling urinary catheter) that could potentially affect the duration of immobility.

All patients were followed up, and the FIM and mortality were obtained by telephone at 2 and 6 months. Additional deaths were identified from hospital records, interviews with family or friends, and public records (death certificates). Information on function was available for 79.7% of subjects at 6 months, and 13.3% had died.

RESULTS

Most subjects were women (82.0%), and the median age was 83 years. Only 10.5% resided in nursing homes at baseline, and 28.2% reported dementia (Table 1). The mean±SD number of hours from hospital arrival to surgery was 40.8±4.86 (interquartile range, 20.5-45.4). By postoperative day 1, 201 subjects (37.9%) were mobilized to a chair and 174 (32.8%) were mobilized beyond a chair. By postoperative day 2, 50.3% were mobilized beyond a chair. Taking preoperative and postoperative immobility together, the mean±total number of days of immobility was 5.2±5.9 (interquartile range, 2.7-5.8; skewness, 6.4).

Duration from arrival to surgery was associated with baseline locomotion, comorbidity, abnormal clinical findings on admission, and hospital site (Table 1). Post-operative immobility and total immobility were associated with baseline locomotion, comorbidity, and abnormal clinical findings on admission and also with baseline living situation, dementia, locomotion, and fracture characteristics.

Of the patients, 19.7% reported having 3 or more days of moderate or severe pain, 41.2% received general anesthesia, and 53.9% received postoperative transfusions; 22.5% did not have their indwelling urinary catheter removed by postoperative day 3. The total duration of immobility was...
associated with increased pain, general anesthesia, having blood transfusions, and the presence of an indwelling urinary catheter beyond postoperative day 3. Controlling for baseline characteristics, pain, general anesthesia, transfusion, and indwelling catheters all remained associated with longer duration of immobility.

Table 2 summarizes regressions for the association of immobility with mortality and functional outcomes controlling for other factors. Preoperative locomotion was a consistent predictor of mortality and all functional outcomes.

**IMMOBILITY AND OUTCOMES**
operative immobility was associated (preoperative immobility was not associated with death or effects of preoperative and postoperative immobility, bility. In regression analyses examining the separate ef-
diated largely through its effect on postoperative immo-
longer significant.

When patients with delirium or complications were ex-
cluded, the effect of immobility on function at 2 months
immobility with function attenuated between 2 and 6
months. Similar results were obtained when patients with
immobility exceeding the 90th percentile were excluded.

The association of immobility with outcomes was me-
4 months, and mortality effects were no

Abbreviation: CI, confidence interval.

Table 3. Adjusted Outcomes Associated With Days of Immobility at the 10th, 50th, and 90th Percentile Values

<table>
<thead>
<tr>
<th>Outcome</th>
<th>10th Percentile (95% CI)</th>
<th>50th Percentile (95% CI)</th>
<th>90th Percentile (95% CI)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Death by 6 mo. % (n = 532)</td>
<td>5.3 (3.0-8.5)</td>
<td>7.3 (4.9-10.4)</td>
<td>10.7 (6.8-15.8)</td>
<td>.01</td>
</tr>
<tr>
<td>Locomotion at 2 mo. (n = 447)</td>
<td>7.2 (6.7-7.6)</td>
<td>6.7 (6.4-7.0)</td>
<td>6.2 (5.7-6.6)</td>
<td>.008</td>
</tr>
<tr>
<td>Self-care at 2 mo. (n = 430)</td>
<td>30.9 (29.6-32.3)</td>
<td>29.4 (28.5-30.2)</td>
<td>27.4 (26.1-29.2)</td>
<td>.002</td>
</tr>
<tr>
<td>Transferring at 2 mo. (n = 437)</td>
<td>14.1 (13.5-14.7)</td>
<td>13.1 (12.7-13.5)</td>
<td>12.0 (11.3-12.6)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Locomotion at 6 mo. (n = 412)</td>
<td>8.4 (8.0-8.9)</td>
<td>8.1 (7.8-8.4)</td>
<td>7.8 (7.4-8.3)</td>
<td>.14</td>
</tr>
<tr>
<td>Self-care at 6 mo. (n = 419)</td>
<td>31.4 (30.1-32.7)</td>
<td>31.2 (30.4-32.0)</td>
<td>31.0 (29.7-32.2)</td>
<td>.67</td>
</tr>
<tr>
<td>Transferring at 6 mo. (n = 419)</td>
<td>15.4 (14.8-16.0)</td>
<td>14.9 (14.6-15.4)</td>
<td>14.5 (13.8-15.2)</td>
<td>.09</td>
</tr>
</tbody>
</table>

at 2 and 6 months. Dementia diagnosis and nursing home
residence were consistently associated with all functional
outcomes but not with mortality. Increased total immo-
bility was associated with increased mortality at 6 months
and with all functional outcomes at 2 months. In all cases
(locomotion, self care, and transferring), the association
of immobility with function attenuated between 2 and 6
months. Similar results were obtained when patients with
immobility exceeding the 90th percentile were excluded.
When patients with delirium or complications were ex-
cluded, the effect of immobility on function at 2 months
was similar and significant. However, immobility was
associated with worse locomotion (P = .002) and trans-
fering (P = .001) at 6 months, and mortality effects were no
longer significant.

The association of immobility with outcomes was medi-
ated largely through its effect on postoperative immob-
ility. In regression analyses examining the separate ef-
effects of preoperative and postoperative immobility,
preoperative immobility was not associated with death or
functional outcomes at 2 or 6 months. In contrast, post-
operative immobility was associated (P < .05 for all coef-
ficients) with worsened 6-month survival and 2-month
function (self-care, transferring, and locomotion) even af-
fter controlling for preoperative immobility. The greater
strength of the association between postoperative immo-
bility and outcomes may have been due to the greater mag-
nitude and variability in postoperative (relative to preop-
ervative) immobility. Predicted outcomes are given in
Table 3 to quantify the magnitude of the effect in the en-
tire cohort at the 10th (2.0 days), 50th (3.8 days), and 90th
(8.2 days) percentile of total immobility. Compared with
patients at the 90th percentile of immobility in adjusted
analyses, patients at the 10th percentile had lower 6-month
mortality (~5.4%; 95% confidence interval [CI], 10.9% to~1.0%),
better FIM locomotion score (0.99 points; 95% CI,
0.3 to 1.7 points; range of scores, 2-14, with higher
values indicating better function), but no significant dif-
ficence in locomotion by 6 months (0.58 points; 95% CI,
~0.3 to 1.4 points).

Compared with patients at the 90th percentile of im-
obility or greater, patients at the 10th percentile or less
had better pain control (5.9% vs 40.0% reported having
more than 3 days of moderate or severe pain; P < .001),
We repeated the adjusted analyses to examine the effect of immobility on outcomes in 2 subgroups (Table 4): patients who were either independent or using personal assistance or supervision for locomotion at baseline. The association of immobility with outcomes was in the expected direction in both subgroups at both time points. For more independent patients, the difference in 6-month functional outcomes attenuated by 6 months (P = .004) and only 1.2% (P = .38) for all outcomes at 2 months and larger than that observed among the more independent patients. The effect sizes were smaller in the independent subgroup and significant (P = .04) only for locomotion at 2 months, perhaps owing to the small sample size. For both subgroups, the association of immobility with function was not significant at 6 months.

**SUBGROUP ANALYSES**

We found that patients with a hip fracture experience on average a day less of immobility in the hospital. Increased immobility was associated with higher mortality at 6 months and poorer function at 2 months. The difference in functional outcomes attenuated by 6 months as patients recovered function. The potentially adverse effect of immobility was strongest in patients more dependent in mobility at baseline. Finally, we found that increased immobility was associated with several potentially modifiable processes of care that represent opportunities to improve functional outcomes.

Some processes of care in hip fracture have been shown to have no significant direct effect on outcomes but may have an effect on immobility. Other processes (eg, management of pain) have an association with outcomes perhaps, in part, through an effect on immobility. Although previous studies have examined the effects of these and other specific processes, to our knowledge no studies have previously examined the association of immobility per se with outcomes. Hence, we considered the association of immobility on outcomes, controlling for baseline characteristics at hospital arrival but not factoring in the processes of care occurring after hospitalization, whose effects on outcomes might be mediated through immobility.

This study was limited by its observational design. However, we used detailed clinical data to account for the baseline functional status of patients, whether they had dementia and/or the presence of other chronic medical conditions and whether the patients received assistance in the community or in nursing homes. We also accounted for other reasons for delayed mobilization. We used detailed clinical and laboratory data on abnormalities present on hospital admission that may have delayed surgery and increased immobility, considered the possible effects of complications, and took type of fracture and surgery into consideration. Although data from a randomized trial would be desirable, no randomized trial could ever be conducted that would assign patients with hip fracture to increased bed rest and immobility.

In addition, our study was limited by sample size for the subgroup analyses and for 6-month effects. Furthermore, the FIM had practical (self-report and proxy response feasibility) advantages for this study; however, the FIM does not explicitly include endurance, balance, and mobility.

**Table 4. Adjusted Outcomes Associated With Days of Immobility for Subgroups**

<table>
<thead>
<tr>
<th>Outcome</th>
<th>10th Percentile (95% CI)</th>
<th>50th Percentile (95% CI)</th>
<th>90th Percentile (95% CI)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Death by 6 mo, % (n = 257)</td>
<td>11.3 (6.5-18.1)</td>
<td>17.7 (13.4-23.6)</td>
<td>28.4 (20.2-38.2)</td>
<td>.004</td>
</tr>
<tr>
<td>Locomotion at 2 mo (range 2-14) (n = 203)</td>
<td>5.2 (4.6-5.9)</td>
<td>4.7 (4.3-5.1)</td>
<td>4.0 (3.4-4.7)</td>
<td>.03</td>
</tr>
<tr>
<td>Self-care at 2 mo (range 6-42) (n = 192)</td>
<td>25.7 (23.4-27.9)</td>
<td>22.9 (21.5-24.4)</td>
<td>19.1 (16.7-21.6)</td>
<td>.004</td>
</tr>
<tr>
<td>Transferring at 2 mo (range 3-21) (n = 200)</td>
<td>12.0 (11.0-13.0)</td>
<td>10.4 (9.7-11.0)</td>
<td>8.3 (7.2-9.3)</td>
<td>.001</td>
</tr>
<tr>
<td>Locomotion at 6 mo (range 3-21) (n = 189)</td>
<td>6.3 (5.5-7.1)</td>
<td>5.8 (5.4-6.2)</td>
<td>5.3 (4.6-6.0)</td>
<td>.09</td>
</tr>
<tr>
<td>Self-care at 6 mo (range 6-42) (n = 181)</td>
<td>24.2 (21.9-26.5)</td>
<td>24.3 (22.9-25.7)</td>
<td>24.3 (22.1-26.5)</td>
<td>.04</td>
</tr>
<tr>
<td>Transferring at 6 mo (range 3-21) (n = 184)</td>
<td>12.5 (11.4-13.6)</td>
<td>11.9 (11.3-12.6)</td>
<td>11.4 (10.3-12.5)</td>
<td>.22</td>
</tr>
</tbody>
</table>

Abbreviation: CI, confidence interval.
other detailed aspects of mobility. Hence, some of the trends observed in subgroup analyses and at 6 months may have been nonsignificant owing to power or to limitations in measurement.

Some might argue that the outcome differences that we observed were statistically significant but relatively modest and short term. The 2-month adjusted FIM locomotion and transfer measures differed by only 1 point when comparing the 10th and 90th percentile of immobility. In the range of scores we observed, a 1-point change in these measures amounts to the difference between needing minimal personal assistance or just needing personal supervision with no assistance in walking 150 ft (45 m) or transferring. Faster and earlier recovery of function can have large implications for caregiving. For some patients, a 1-point difference on the FIM scale can be the difference between being able to go home or not depending on the availability of an able-bodied caregiver to provide the needed assistance.

Our results are clinically and biologically plausible and relevant. Early mobility enhanced early recovery, particularly in patients more dependent in mobility at baseline. We found that the more dependent subgroup was older and had greater comorbidity, suggesting that this subgroup was more vulnerable, had more limited homeostasis, and was more likely to benefit from early mobilization. Once mobilized, further mobilization in these patients may have been less in frequency and intensity. Given the frequency of intercurrent events and readmission in patients with hip fracture, it also should not be surprising that the effect of immobility attenuated by 6 months. Indeed, we found that immobility was associated with 6-month function only when we excluded patients who developed intercurrent delirium and complications from the analysis. Although we observed considerable delay in surgery, there was much greater variation in postoperative delay; hence, it is not surprising that the effect of immobility was mediated largely by postoperative delay. The findings are also consistent with studies from other populations that have documented the deleterious effects of immobility on intermediate outcomes involving various organ systems.1-4 Finally, although length of stay continues to decrease, our findings remain relevant because the latest figures indicate that length of stay continues to decrease, our findings remain relevant because the latest figures indicate that length of stay has decreased by only 0.2 days from

Alternative text content that was presumably extracted from the image is here: that length of stay has decreased by only 0.2 days from effects of postoperative transfusions. Consideration should be given to mobilizing patients and allowing them to bear weight as tolerated early in the postoperative course. Studies have shown that moving in bed and using a bedpan can generate forces across the hip approaching those resulting from ambulation, and early mobilization has been shown not to increase the rate of surgical revisions.17 Changes in the financing and complexity of medical care have led to limited and sometimes overwhelmed staff in America’s hospitals.18 Under these circumstances, failing to get a patient with hip fracture out of bed can be less visible omission in care. Our study documents, at least in patients with hip fracture and possibly in other vulnerable hospitalized patients, the deleterious effects of failing in this low technological act.

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REFERENCES