Reducing Delirium After Hip Fracture: A Randomized Trial

Edward R. Marcantonio, MD, SM,[*†‡] *Jonathan M. Flacker, MD,*[†‡] *R. John Wright, MD,*[§] *and Neil M. Resnick, MD*[*†‡¶]

OBJECTIVES: Delirium (or acute confusional state) affects 35% to 65% of patients after hip-fracture repair, and has been independently associated with poor functional recovery. We performed a randomized trial in an orthopedic surgery service at an academic hospital to determine whether proactive geriatrics consultation can reduce delirium after hip fracture.

DESIGN: Prospective, randomized, blinded.

SETTING: Inpatient academic tertiary medical center.

PARTICIPANTS: 126 consenting patients 65 and older (mean age 79 ± 8 years, 79% women) admitted emergently for surgical repair of hip fracture.

MEASUREMENTS: Detailed assessment through interviews with patients and designated proxies and review of medical records was performed at enrollment to ascertain prefracture status. Subjects were then randomized to proactive geriatrics consultation, which began preoperatively or within 24 hours of surgery, or "usual care." A geriatrician made daily visits for the duration of the hospitalization and made targeted recommendations based on a structured protocol. To ascertain study outcomes, all subjects underwent daily, blinded interviews for the duration of their hospitalization, including the Mini-Mental State Examination (MMSE), the Delirium Symptom Interview (DSI), and the Memorial Delirium Assessment Scale (MDAS). Delirium was diagnosed using the Confusion Assessment Method (CAM) algorithm.

RESULTS: The 62 patients randomized to geriatrics consultation were not significantly different ($P > .1$) from the 64 usual-care patients in terms of age, gender, prefracture dementia, comorbidity, type of hip fracture, or type of surgical repair. Sixty-one percent of geriatrics consultation patients were seen preoperatively and all were seen within 24 hours postoperatively. A mean of 10 recommendations were made throughout the duration of the hospitalization, with 77% adherence by the orthopedics team. Delirium occurred in 20/62 (32%) intervention patients, versus 32/64 (50%) usual-care patients ($P = .04$), representing a relative risk of 0.64 (95% confidence interval (CI) = 0.37–0.98) for the consultation group. One case of delirium was prevented for every 5.6 patients in the geriatrics consultation group. There was an even greater reduction in cases of severe delirium, occurring in 7/60 (12%) of intervention patients and 18/62 (29%) of usual-care patients, with a relative risk of 0.40 (95% CI = 0.18–0.89). Despite this reduction in delirium, length of stay did not significantly differ between intervention and usual-care groups (median ± interquartile range = 5 ± 2 days in both groups), likely because protocols and pathways predetermined length of stay. In subgroup analyses, geriatrics consultation was most effective in reducing delirium in patients without prefracture dementia or activities of daily living (ADL) functional impairment.

CONCLUSIONS: Proactive geriatrics consultation was successfully implemented with good adherence after hip-fracture repair. Geriatrics consultation reduced delirium by over one-third, and reduced severe delirium by over one-half. Our trial provides strong preliminary evidence that proactive geriatrics consultation may play an important role in the acute hospital management of hip-fracture patients. **J Am Geriatr Soc 49:516–522, 2001.**

Key words: delirium; confusion; hip fracture; older; geriatrics consultation

From the *Division of General Medicine and the [§]Department of Orthopedic Surgery, Brigham and Women's Hospital, Boston, Massachusetts; the [†]Department of Medicine and Research and Training Institute, Hebrew Rehabilitation Center for Aged, [‡]Division on Aging, Harvard Medical School; and the [¶]Division of Geriatric Medicine, University of Pittsburgh School of Medicine, Pittsburgh, Pennsylvania.

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Address correspondence to Edward R. Marcantonio, MD, Department of Medicine, Hebrew Rehabilitation Center for Aged, 1200 Centre Street, Boston, MA 02131.

Over 250,000 older Americans fracture a hip each year, leading to direct medical costs in excess of 10 billion dollars.[1] Delirium, or an acute confusional state, is common after hip-fracture repair, occurring in 35% to 65% of patients.[2] We recently demonstrated that delirium

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is independently associated with poor functional recovery after hip fracture, even after adjusting for prefracture frailty.[3] A recent study demonstrated that delirium is preventable in general medical patients using a unit-based multifactorial intervention,[4] but the applicability of this strategy to surgical patients has not been examined.

Geriatrics consultation is a relatively easily implemented, generalizable intervention strategy for frail hospitalized older people.[5,6] Previous studies have reported mixed results of geriatrics consultation.[5] The keys to effectiveness seem to be careful targeting of the population, a proactive rather than a reactive strategy, and intervention on defined outcomes rather than global "geriatrics assessment."[7,8] Hip fracture identifies an ideal target population for geriatrics consultation, and delirium is a common and morbid outcome in which to intervene. Therefore, we performed a randomized trial to determine whether proactive geriatrics consultation can reduce delirium after hip-fracture repair.

METHODS

Subjects

All patients age 65 and older admitted to an academic tertiary medical center for primary surgical repair of hip fracture were eligible for the study. All orthopedic surgeons performing hip-fracture repairs permitted the investigators to approach their patients for participation. Exclusion criteria included the presence of metastatic cancer or other comorbid illnesses likely to reduce life expectancy to less than 6 months, or inability to obtain informed consent within 24 hours of surgery or 48 hours of admission. Informed consent was obtained through a protocol approved by the institutional review board; if the subject demonstrated evidence of dementia or delirium at the time of enrollment, consent was also obtained from the designated healthcare proxy.

Intake Assessment

All subjects underwent an intake assessment that included a patient interview, a proxy interview, and a review of the medical record. The patient interview included: (1) an assessment of prefracture self-care function using activities of daily living (ADLs),[9] which include bathing, dressing, ability to use the toilet, continence, transfers, and feeding (scored 0–6, 6 best); (2) an assessment of postfracture cognitive function using the Mini-Mental State Examination (MMSE) (scored 0–30, 30 best);[10] (3) elicitation of individual symptoms of delirium using the Delirium Symptom Interview (DSI);[11] (4) measurement of the severity of delirium using the Memorial Delirium Assessment Scale (MDAS) (scored 0–30, 30 worst);[12] (5) the ascertainment of delirium using the Confusion Assessment Method (CAM) diagnostic algorithm.[13] The proxy interview included an assessment of the patient's prefracture ADL function and an assessment of the patient's prefracture cognitive status using the Blessed Dementia Rating Scale (designed for use by proxies, score 0–28, 0 best).[14]

The diagnosis of prefracture dementia was based on a Blessed score of 4 or higher (standard cutoff).[14] If the subject was considered demented or delirious, the assessment of prefracture ADL function was based on the proxy interview; otherwise it was based on the patient interview. Subjects with ADL scores of less than 5 (having impairments in more than one full ADL) were considered to have prefracture ADL impairment.

The Intervention

After the intake assessment, subjects were randomized to proactive geriatrics consultation or usual care by opening a sealed envelope containing the randomization assignment derived from a random number table. Subjects randomized to the intervention group underwent geriatrics consultation preoperatively or within 24 hours postoperatively. A geriatrician performed daily visits for the duration of the hospitalization and made targeted recommendations based on a structured protocol. This protocol, which included 10 modules each containing two to five specific recommendations, is further described below. To improve adherence, recommendations were prioritized and limited to no more than five after the initial visit and no more than three after follow-up visits. The usual-care group received management by the orthopedics team, including internal medicine or geriatrics consults on a reactive rather than proactive basis.

Assessment of Delirium

The primary outcome of this trial was total cumulative incidence of delirium throughout the acute hospital stay. A target sample size of 125 patients was selected to achieve 80% power to detect a one-third reduction of delirium in the intervention group compared with usual care. Patients underwent daily interviews from the day of enrollment until the day of discharge. These interviews included the MMSE, DSI, and MDAS, and delirium was assessed using the CAM diagnostic algorithm. The CAM requires that the patient demonstrate an acute change in mental status with a fluctuating course, inattention, and either disorganized thinking or an altered level of consciousness.[13] The CAM has been validated against expert psychiatrist's diagnoses and has been shown, when operationalized by trained research interviewers, to be highly sensitive and specific, even in populations with a high prevalence of dementia.[13] Our approach of combining the MMSE, DSI, MDAS, and CAM is even more detailed than that used by Inouye in her studies.[13] The research interviewer was trained in the use of these instruments[15] and conducted the assessments blinded to the intervention status of the subjects. Blinding was successfully maintained on all enrolled subjects by staggering the timing of the geriatrician and interviewer patient encounters.

A secondary outcome of this trial was the cumulative incidence of severe delirium throughout the acute hospitalization. Severe delirium was CAM-defined delirium in which the MDAS score was 18 or higher (of a possible 30) on at least one hospital day. Eighteen was picked as the cutoff for severe delirium because 17 was the median of the highest daily MDAS score among all patients who developed delirium in both intervention and control groups.

Medical Record Review

The medical record was reviewed to obtain a list of medical comorbidities based on the Charlson comorbidity index[16] and to confirm demographic data and place of res-

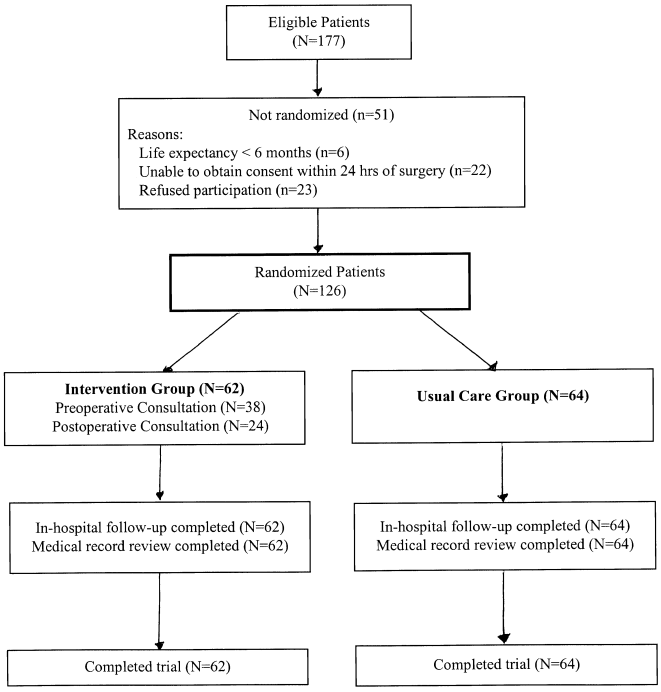

Figure 1. Flow diagram for randomized trial.

idence. The medical record was also reviewed to obtain information about the type of fracture (femoral neck, intertrochanteric, other) and the type of surgical repair (internal fixation, hip replacement, other). Total hospital length of stay and discharge disposition, which were secondary outcome measures, were also obtained from the medical record. Since the geriatrician's consultation notes were in the medical record, this review was not blinded to the intervention status of the patient but was conducted by an independent nurse reviewer who did not communicate with the research interviewer performing delirium assessments.

Data Analysis

All statistical analyses were performed on an "intention to treat" basis using the SAS statistical package.[17] Bivariable associations of intervention status with prefracture characteristics, delirium, and one-month outcomes were performed using chi-square and Student's *t* tests. Because length of hospital stay was not normally distributed, it was described by the median ± interquartile range, and statistical comparisons were made using the Wilcoxon rank sum test. Imbalances in prefracture characteristics between the intervention and usual-care groups large enough to potentially affect the results were adjusted for using logistic regression. We also performed stratified analyses to assess the effectiveness of the intervention within prespecified subgroups of importance to geriatricians: patients with prefracture dementia or ADL functional impairment.

RESULTS

Study Population, Prefracture Characteristics

As shown in Figure 1, 177 hip-fracture patients age 65 and older were admitted to the study hospital during the study period. Of these, 28 (16%) were excluded because of a life expectancy less than 6 months or inability to obtain informed consent within the required time window, usually due to unavailability of study personnel. An additional 23 (13%) refused participation. The mean age, gender, race, and place of residence among participants were not significantly different from nonparticipants, and were similar to nationwide demographic characteristics of hip-fracture patients.[1] All 126 consenting patients were successfully randomized to geriatrics consultation (n = 62) or usual care (n = 64), and follow-up was completed on all randomized subjects. Table 1 compares prefracture patient characteristics in the geriatrics consultation and usual-care groups. There were no statistically significant differences ($P < .1$) in any of the prefracture characteristics examined, but smaller imbalances ($.1 < P < .2$) existed in two characteristics: prefracture dementia and ADL impairment, both higher in the usual-care group. The intervention patients were slightly older and had higher medical comorbidity, but these differences did not approach statistical significance ($P > .3$).

Content of the Geriatrics Consultation

Sixty-two of the 126 study patients were randomly assigned to proactive geriatrics consultation. Thirty-eight of these patients (61%) had an initial geriatrics consultation

Table 1. Baseline Characteristics of Intervention and Usual-Care Groups

Baseline Factor	Geriatrics Consultation (n = 62)	Usual Care (n = 64)	*P*-Value
Age in years (mean ± SD)	78 ± 8	80 ± 8	.39
Gender (% female)	49 (79%)	50 (78%)	.90
Race (% Caucasian)	56 (90%)	58 (91%)	.95
Prefracture dementia (Blessed score ≥4)	21 (37%)	29 (51%)	.13
Prefracture ADL impairment (Katz ADL score <5)	11 (19%)	18 (31%)	.15
High medical comorbidity (Charlson index ≥4)	24 (39%)	21 (33%)	.49
Type of fracture: femoral neck	32 (52%)	33 (52%)	.99
Surgery—hip replacement	20 (32%)	22 (34%)	.80

SD = standard deviation; ADL = activities of daily living.

Table 2. Content of the Structured Geriatrics Consultation

Module/Recommendation	Recommended n (%)	Adherence n (%)
1. Adequate CNS oxygen delivery:		
a) Supplemental oxygen to keep saturation >90%, preferably >95%	18 (29%)	16 (89%)
b) Treatment to raise systolic blood pressure >2/3 baseline or >90 mmHg	4 (6%)	4 (100%)
c) Transfusion to keep hematocrit >30%	57 (92%)	45 (79%)
2. Fluid/electrolyte balance:		
a) Treatment to restore serum sodium, potassium, glucose to normal limits (glucose <300 mg/dl, <16.5 mmol/L for diabetics)	23 (37%)	22 (96%)
b) Treat fluid overload or dehydration detected by examination or blood tests	30 (48%)	27 (90%)
3. Treatment of severe pain:		
a) Around-the-clock acetaminophen (1 gram four times daily)	25 (40%)	8 (32%)
b) Early-stage break-through pain: low-dose subcutaneous morphine, avoid meperidine	13 (21%)	8 (62%)
c) Late-stage break-through pain: oxycodone as needed	3 (5%)	2 (67%)
4. Elimination of unnecessary medications:		
a) Discontinue/minimize benzodiazepines, anticholinergics, antihistamines	42 (68%)	35 (83%)
b) Eliminate drug interactions, adverse effects, modify drugs accordingly	13 (21%)	7 (54%)
c) Eliminate medication redundancies	8 (13%)	5 (63%)
5. Regulation of bowel/bladder function:		
a) Bowel movement by postoperative day 2 and every 48 hours	42 (68%)	24 (57%)
b) D/c urinary catheter by postoperative day 2, screen for retention or incontinence	44 (71%)	39 (89%)
c) Skin care program for patients with established incontinence	2 (3%)	2 (100%)
6. Adequate nutritional intake:		
a) Dentures used properly, proper positioning for meals, assist as needed	35 (56%)	23 (66%)
b) Supplements: 1 can Ensure,* 3 cans Ensure* for poor oral intake	22 (35%)	10 (45%)
c) If unable to take food orally, feed via temporary nasogastric tube	1 (2%)	1 (100%)
7. Early mobilization and rehabilitation:		
a) Out of bed on postoperative day 1 and several hours daily	36 (58%)	29 (81%)
b) Mobilize/ambulate by nursing staff as tolerated, such as to bathroom	18 (29%)	13 (72%)
c) Daily physical therapy; occupational therapy if needed	1 (2%)	1 (100%)
8. Prevention, early detection, and treatment of major postoperative complications:		
a) Myocardial infarction/ischemia—electrocardiogram, cardiac enzymes if needed	21 (34%)	17 (81%)
b) Supraventricular arrhythmias/atrial fibrillation—appropriate rate control, electrolyte adjustments, anticoagulation	3 (5%)	3 (100%)
c) Pneumonia/chronic obstructive pulmonary disease—screening, treatment, including chest therapy	27 (44%)	18 (67%)
d) Pulmonary embolus—appropriate anticoagulation	31 (50%)	31 (100%)
e) Screening for and treatment of urinary tract infection	32 (52%)	20 (63%)
9. Appropriate environmental stimuli:		
a) Appropriate use of glasses and hearing aids	3 (5%)	2 (67%)
b) Provision of clock and calendar	0 (0%)	—
c) If available, use of radio, tape recorder, and soft lighting	0 (0%)	—
10. Treatment of agitated delirium:		
a) Appropriate diagnostic workup/management	1 (2%)	1 (100%)
b) For agitation, calm reassurance, family presence, and/or sitter	2 (3%)	2 (100%)
c) For agitation, if absolutely necessary, low-dose haloperidol 0.25–0.5 mg every 4 hours as needed; if contraindicated, use lorazepam at same dose	12 (19%)	10 (83%)

Recommended = number (%) of intervention patients in whom the recommendation was made.
Adherence = in those recommended, number (%) who adhered to the recommendation.
CNS = central nervous system; d/c = discontinue.
*Ensure is the trade name of a nutritional supplement.

completed preoperatively; the remainder had the initial consultation completed within 24 hours of surgery. There were 591 recommendations throughout the hospitalization, or a mean of 9.5 recommendations per patient (range 3–21). The overall adherence rate by the orthopedics team was 77%. Table 2 describes the specific content of the structured geriatrics consultation by reporting the frequency of and adherence to specific recommendations of the geriatrics consultant. This table does not describe overall management practices, therefore comparable data are not available for the usual-care group. It should also be noted that the consultants did not recommend things that the orthopedists or nurses were already doing; recommendations were made only when something was not being done that they felt should be.

There was significant variability in the frequency with which specific recommendations were made, and in adherence to specific recommendations. Those recommenda-

Table 3. Impact of Geriatrics Consultation on Delirium

Outcome	Geriatrics Consultation (n = 62)	Usual Care (n = 64)	*P*-Value
Delirium: cumulative incidence during acute hospitalization	20 (32%)	32 (50%)	.04
Severe delirium: cumulative incidence during acute hospitalization	7 (12%)	18 (29%)	.02
Hospital days of delirium per episode (mean ± SD)	2.9 ± 2.0	3.1 ± 2.3	.72
Hospital length of stay (median ± IQR)	5 ± 2	5 ± 2	.95
Discharged to institutional setting (nursing home, rehab hospital)	92%	88%	.41
Delirium at hospital discharge	8 (13%)	12 (19%)	.35

Notes: Delirium was diagnosed using the Confusion Assessment Method (CAM) diagnostic algorithm[12] after daily interviews with the patient that included the Mini-Mental State Examination (MMSE)[10] and the Delirium Symptom Interview (DSI).[11]
Severe delirium was defined as any CAM-defined delirium that had a score of 18 or higher on the Memorial Delirium Assessment Scale ((MDAS) median maximum score = 17) on one or more hospital days.
SD = standard deviation; IQR = interquartile range.

tions frequently made and adhered to included transfusing to keep the hematocrit greater than 30%, discontinuing or limiting use of psychoactive medications, and discontinuing urinary catheters by postoperative day 2, with subsequent monitoring and treatment of retention or incontinence. The impact of a specific recommendation can be estimated by multiplying its frequency and adherence. For example, a recommendation to reduce or discontinue psychoactive medications was made in 68% of the intervention group, with 83% adherence. Thus, in 83% of 68%, or 56% of the intervention group, high-risk psychoactive medications were reduced or eliminated based on the recommendations of the consultant. Other recommendations related to pain management; nutrition; drug interactions; and prevention, detection and treatment of postoperative complications had lower adherence. Although the consultation was as structured as possible, the prioritization and specific implementation of the structured recommendations required the judgment of the consulting physician.

Impact of Geriatrics Consultation on Delirium

The impact of geriatrics consultation on delirium is described in Table 3. There was a statistically significant reduction in delirium in the geriatrics consultation group compared with the usual-care group (20/62 vs 32/64, $P = .04$, relative risk (RR) = 0.64, 95% CI = 0.37–0.98). This translates to a "number needed to treat" of 5.6 patients in the geriatrics consultation group to prevent one case of delirium. The intervention was even more effective in preventing severe delirium, with RR = 0.4, 95% CI = 0.19–0.89. Nevertheless, there was no difference between the intervention and usual-care groups in the number of hospital days with delirium per episode of delirium. This suggests that our intervention had little impact on the duration of delirium once it developed.

We adjusted for the previously described imbalance between the consultation and usual-care groups in prefracture dementia and ADL impairment using logistic regression. Adjusting for both prefracture dementia and ADL impairment did not diminish the effect size of the intervention: odds ratio (OR) for prevention of delirium = 0.6, but this was no longer statistically significant, with a 95% CI = 0.3–1.3. Likewise, the adjusted OR for the prevention of severe delirium was essentially unchanged at 0.4, but was no longer statistically significant, with a 95% CI = 0.1–1.2.

Impact of the Intervention on Length of Stay

There was no difference in the length of stay or discharge disposition between geriatrics consultation and usual-care groups (Table 3). The median length of stay ± interquartile range was 5 ± 2 days in both groups. The prevalence of delirium declined similarly in both intervention and usual-care groups so that by discharge the difference was no longer significant: 13% in the intervention group, 19% in the usual-care group, $P = .35$ (Table 3).

Subgroup Analyses

In the subgroup analyses presented in Table 4, geriatrics consultation was more effective in reducing delirium among patients without prefracture dementia or ADL impairment. Because of the relatively small sample size within these subgroups, these effects were not statistically significant. The intervention showed little or no benefit in patients with prefracture dementia or ADL impairment, most of whom became delirious regardless of intervention status.

DISCUSSION

In this report, we demonstrate that, with relatively good adherence by the orthopedics team, proactive geriatrics consultation using a structured multimodular protocol can be successfully implemented for hip-fracture patients. This consultation was associated with a statistically significant one-third reduction in the incidence of delirium in the intervention group compared with usual care and an even greater reduction in the incidence of severe delirium. Reduction in delirium was not associated with shortened length of stay, but length of stay was often predetermined by protocol or critical pathway.

Stratified analyses demonstrated that geriatrics consultation appeared most effective in reducing delirium in patients without prefracture dementia or ADL impairment. In patients with significant prefracture impairment, the stress of hip fracture and its operative repair may be sufficient to precipitate delirium, despite otherwise opti-

Table 4. Impact of Geriatrics Consultation on Delirium in Prespecified Patient Subgroups

Outcome: Cumulative Incidence of Delirium	Geriatrics Consultation (n = 62)	Usual Care (n = 64)	*P*-Value
Stratified by prefracture dementia			
No dementia (n = 64)	7 (19%)	10 (36%)	.14
Dementia (n = 50)	13 (62%)	20 (69%)	.60
Stratified by prefracture functional impairment			
No ADL impairment (n = 86)	12 (26%)	18 (45%)	.07
ADL impairment (n = 29)	8 (73%)	13 (72%)	.98

Notes: Delirium was diagnosed using the Confusion Assessment Method (CAM) diagnostic algorithm[13] after daily interviews with the patient that included the Mini-Mental State Examination (MMSE) [10] and the Delirium Symptom Interview (DSI).[11]
Prefracture dementia was based on a score of 4 or higher on the Blessed dementia rating scale,[14] based on the proxy intake interview.
Prefracture impairment in activities of daily living (ADLs) was based on a score of less than 5 on the Katz ADL scale.[9] If the subject had dementia or delirium, it was based on the proxy interview; otherwise, it was based on the patient interview.

mal management. Less-impaired patients may require additional insults to precipitate delirium, some of which are avertable by geriatrics consultation. This is supported by the summative risk factor model for delirium proposed by Inouye et al.[18] and the general model for geriatrics syndromes that we have proposed.[19]

These findings corroborate and extend those of previous investigations. Inouye et al. recently reported a similar reduction in delirium (matched OR = 0.6, 95% CI = 0.39–0.92) among general medicine patients age 70 and older using a unit-based targeted multifactorial intervention.[4] The intervention included specific protocols for cognitive impairment, sleep hygiene, immobility, visual impairment, hearing impairment, and dehydration carried out by trained lay interventionists and volunteers. We addressed many of the same factors in our multimodular intervention and achieved reductions of delirium of similar magnitude (adjusted OR = 0.6), but our intervention was much more medically based. Because of the very high risk of delirium among hip-fracture patients (usual-care incidence of 50% in our trial) the clinical judgment of a skilled geriatrician may be helpful in prioritizing among many possible interventions to prevent delirium. In addition, the geriatrician can assist the orthopedics team in the management of other medical issues that may arise during the hospitalization. Other approaches such as a specialized unit, nursing-based intervention, or consultation by an appropriately trained internist might also be effective. Determining the most cost-effective strategy for different patient populations requires further study.

Before Inouye's work,[4] the results of interventional trials to prevent delirium had been mixed. A recent review found 10 published trials, only three of which were randomized.[20] Two of these trials were performed in the hip fracture population and neither was randomized. The first, a nursing-based intervention performed in the early 1980s, showed an 8% reduction in delirium.[21] The second, a Geriatric-Anesthesiologic Program performed in Sweden in the late 1980s, showed a larger 14% reduction in delirium, but involved historical controls that spanned several years.[22] Our randomized trial provides a rigorous design and demonstrates that delirium can be reduced in the vulnerable hip fracture population.

Our findings have implications for orthopedic surgeons, internists, and geriatricians involved in the management of hip-fracture patients. Delirium is a common complication in older hospitalized people that has been demonstrated to be independently associated with poor outcomes after hip fracture and other acute illnesses.[3,23–27] Our data suggest that delirium is not inevitable after hip-fracture repair; a significant proportion of delirium can be prevented using a proactive approach. Our structured, multimodular geriatrics consultation provides a potentially easily implemented way to reduce delirium.

Several factors related to the randomized design of our study may have actually led to an underestimation of the benefit of proactive geriatrics consultation. First, 39% of patients enrolled in the intervention group were not seen until after surgery. Many patients were taken directly from the emergency department to the operating room, not allowing time for consultation. Since our intervention was designed to be proactive, it would have been preferable to have seen all patients preoperatively. If integrated into care, there could be a commitment from the orthopedists to wait a few additional hours for the consultant's "clearance" before operating on these patients. Second, we achieved 77% adherence to our consultant's recommendations. While this compares favorably with similarly performed trials,[7,28,29] poor adherence to several of the recommendations may have reduced the effectiveness of the intervention. If geriatrics consultation were systematically integrated into care, there would be a better opportunity to foster a collaborative relationship with the orthopedics team that might lead to better adherence to recommendations. Finally, conducting a randomized trial within a single institution raises the possibility of contamination, in which components of the intervention are applied to the usual-care group. Based on our experience performing consultations in the intervention group, there was no evidence that our management principles were being systematically integrated into routine care (the total number and nature of our recommendations did not change over the course of the study), but more subtle contamination is still a possibility and must be mentioned.

Our study had several methodological limitations. First, and most notably, although our study was randomized, there was an imbalance of the baseline characteristics of the patients in the intervention and usual-care groups. This imbalance was not statistically significant ($P > .1$); however, the factors, prefracture dementia and ADL impairment, are potentially important determinants of delirium risk. Therefore, we performed multivariable analyses

to adjust for these factors. The adjusted analyses showed similar effect sizes to the unadjusted analyses, suggesting that these imbalances did not significantly influence our overall findings; however, the adjusted results were not statistically significant, which relates to the second limitation of our study—the relatively small sample size. The size of the study may have also contributed to the imbalance of prefracture characteristics noted above. Although we had adequate statistical power in bivariable analyses, we had less power for multivariable and stratified analyses, which likely explains why these results were not statistically significant. Third, our intervention involved 10 modules and multiple possible recommendations. Although we have reported what was recommended and the percent adherence, our design does not allow us to answer "What really made the difference?" The reader can speculate that the most common recommendations with the highest adherence were likely to be most important. However, to test this formally would require a much larger study in which individual components of our intervention were tested using a randomized block design. Fourth, in describing the content of our intervention, we report adherence to specific recommendations of the geriatrics consultant, not overall management practices. This is consistent with the data presented in most previously published trials of geriatrics consultation. To obtain similar data for the usual-care group would have required that we conduct "sham consults" in which we actually performed geriatrics consultation and developed recommendations, but did not put them in the chart or communicate them to the orthopedists. We felt this would neither be practical nor ethical. Fifth, while not truly a limitation, our current study focuses on the impact of our intervention on hospital outcomes; its impact on postdischarge outcomes will be reported separately. Finally, our study was performed at a single, academic hospital and the intervention was carried out by a limited number of geriatrics consultants and orthopedic surgeons. Our proactive, multimodular consultation might be even more effective in community hospitals; however, it must be tested in this setting to ensure its generalizability.

Our findings demonstrate that delirium is not inevitable, even among highly vulnerable patients undergoing hip fracture surgery. Using proactive structured geriatrics consultation, we prevented one-third of delirium after hip-fracture repair and reduced severe cases of delirium by over one-half. Because delirium is a common and morbid complication after hip fracture surgery, our findings may point to a relatively easily implemented approach to improve outcomes for a vulnerable patient population. Confirming the effectiveness of our intervention strategy in larger and more varied populations is an important area for future research.

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