The Medical Consultant's Role in Caring for Patients with Hip Fracture

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Background: Hip fractures are an important cause of death and functional dependence in the United States.

Purpose: To review the evidence for clinical decisions that medical consultants make for patients with hip fracture and to develop recommendations for care.

Data Sources: Published reports of clinical studies were found by searching MEDLINE and selected bibliographies.

Study Selection: Studies were included if data were presented on clinical interventions to improve care of conditions typically encountered by medical consultants in the care of patients with hip fracture. Such conditions include timing of surgery, infection prophylaxis, thromboembolic prophylaxis, postoperative nutritional management, urinary tract management, prevention and management of delirium, application and timing of rehabilitation services, and prevention of subsequent falls. Meta-analyses; randomized, controlled trials; or other controlled studies were included if possible. If no such trials were identified, the best evidence from studies with other designs was included.

Data Extraction: Interventions were selected on the basis of their efficacy or potential efficacy in improving functional outcome. Trials with positive and negative results were compared for differences in intervention and strength of study methods.

Data Synthesis: Strong evidence supports medical recommendations for decisions about timing and duration of prophylactic antibiotics, selection of thromboembolic prophylaxis, urinary tract and nutritional management, and rehabilitative services. Many case series support early surgical repair, although patients who would benefit from delay and further medical work-up have not been well identified. Evidence for decisions about assessment of subsequent risk for fall and risk for and management of delirium is based largely on data from patients without hip fracture but is probably applicable. Future research should target optimal duration of thromboembolic prophylaxis, cost-effectiveness of low-molecular-weight heparin compared with that of other thromboembolic prophylactic regimens, management of delirium, rehabilitative services, and efficacy of assessment of risk for later falls.

Conclusions: The data suggest that evidence-based medical care can improve hip fracture outcomes. The medical consultant has a key role in providing this care and managing the preoperative conditions and postoperative complications that may affect optimal functional recovery.

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Hip fractures are an important cause of death and functional dependence. Approximately 250 000 hip fractures occur annually in the United States, and this number is expected to increase several fold in the coming decades (1). The mortality rate for persons in the U.S. Medicare population who sustain a hip fracture is 7% at 1 month, 13% at 3 months, and 24% at 12 months (2). For patients who survive to 6 months, 60% recover their prefracture walking ability, half recover their prefracture ability to perform activities of daily living, and about 25% recover their prefracture ability to perform instrumental activities of daily living (3). However, after 1 year, only 54% of surviving patients can walk unaided and only 40% can perform independently all physical activities of daily living (3).

Although surgical repair of the fractured extremity is the cornerstone of therapy, available data suggest that the factors crucial to optimal functional recovery in hip fracture are independent of fracture repair and are instead related to prefracture conditions and postfracture complications (4). Thus, successful care and outcome of patients with hip fracture require an active partnership between the orthopedic surgeon and others, including the medical consultant.

The medical consultant's role includes medical evaluation and stabilization of the patient before surgery, prevention and management of postoperative complications (such as delirium), and follow-up after increasingly shorter hospital visits. Despite the involvement of medical consultants in the care of most patients with hip fracture (in one large series of patients with hip fracture, 81% had a presurgical medical consultation [Magaziner J. Personal communication]), many internists have no formal training in this condition and may be unfamiliar with the optimal management of its complications.

We review the clinical evidence to support decisions that internists are often asked to make for patients with hip fracture, develop evidence-based recommendations, and identify areas requiring further research. Medical decisions include decisions about timing of surgery, infection prophylaxis, thromboembolic prophylaxis, postoperative nutritional management, urinary tract management, prevention and management of delirium, application and timing of rehabilitation services, and prevention of subsequent falls. We excluded preoperative risk assessment and fracture prevention because extensive literature on these subjects already exists. We also excluded topics not usually under the purview of the medical consultant, such as choice of anesthesia and type of surgical repair.

Methods

We did a systematic review of processes related to the medical care of patients with hip fracture, concentrating on processes that could lead to improved functional outcome (**Table 1**). We searched the MEDLINE database, using the MeSH terms *femoral fractures, hip fractures,* or *femoral neck fractures* and the keywords or text words given in **Table 1**, for English-language articles published from January 1966 through June 1997. If no studies were identified, we repeated the search with only the keywords or text words. Articles were reviewed to determine their relevance to patients with hip fracture (for example, elderly persons or patients undergoing lower-extremity orthopedic procedures, such as total hip arthroplasty). To identify additional studies, we searched the reference lists of the selected articles. Within each subject area, we included meta-analyses; randomized, controlled trials; or other controlled studies wherever possible. If no such trials were identified, we included the best available evidence from studies with other designs. Articles were reviewed independently by two of the authors, the evidence was summarized, and recommendations were drafted. If the reviewers disagreed about a recommendation, the underlying assumptions leading to the recommendation were discussed until consensus was reached. Summaries were subsequently reviewed by a panel of content experts in orthopedics, internal medicine, geriatrics, rehabilitation, nursing, and nutrition and were revised on the basis of the panel's recommendations. Final summaries were prepared, and the quality of evidence was rated by using ratings adapted from the U.S. Preventive Services Task Force (5). Meta-analysis was beyond the scope of this paper given the multiple domains, the heterogeneity of study populations, and the wide variation in quality and design of the studies.

Summary of Evidence

A summary of the studies and the strength of the evidence is given in **Table 2**.

Table 1. Key Words and Text Phrases Used in MEDLINE Search

Subject	Keywords and Text Phrases
Hip fracture	*hip-fractures, femoral-neck-fractures, femur-fractures*
Delirium	*delirium, confusion*
Rehabilitation	*rehabilitation*
Falls assessment	*accidental-falls*
Nutrition	*nutrition, parenteral-nutrition, nutritional-status*
Prophylactic antibiotics	*premedication, antibiotic-prophylaxis, antibiotics*
Thromboembolic prophylaxis	*thromboembolism, thrombosis, embolism, deep venous thrombosis*
Timing of surgery	*timing, delay*
Urinary tract management	*urinary-retention; urinary-incontinence; catheters, indwelling; urinary tract infections*

Timing of Surgery

The timing of surgical repair of hip fracture may affect patient outcomes in two ways. Delay in surgical repair, which causes delay in return to weight bearing, may affect functional recovery. Conversely, failure to stabilize medical problems before surgery may increase risk for perioperative complications. Although the orthopedist schedules surgery, the rate-limiting step in this process is often the internist's preoperative medical evaluation.

We identified 9 cohort studies (6, 7, 9, 10, 54–58); 1 randomized, controlled trial of anesthetic techniques that included surgical delay as an independent variable (8); and 1 autopsy series (59) that examined the effects of operative timing on postoperative outcome. The results of these 11 studies suggest that early surgical repair (within 24 to 48 hours) is associated with a reduction in 1-year mortality. However, most of the studies either did not control for the presence and severity of comorbid conditions or excluded patients with complicating medical conditions; thus, these data are difficult to interpret. Of the 5 studies that attempted to control for comorbid conditions (6–10), 4 reported lower mortality rates and 1 (6) reported a lower incidence of confusion and pressure ulcers in patients who underwent surgical repair within 48 hours.

Evidence from cohort studies indicates that for medically stable patients who do not have active comorbid illness (such as unstable angina), surgical repair of hip fracture within the first 24 to 48 hours of admission is associated with a decrease in 1-year mortality. Patients who would benefit from delay and further medical evaluation have not been well characterized.

Prophylactic Antibiotics

Prophylactic antimicrobial agents are often administered to prevent postoperative wound infections. We reviewed the literature to identify the benefit of antibiotic use for postoperative infections and to identify the optimal timing of administration and duration of use. Three meta-analyses examined prophylactic antibiotic use in patients with hip fracture (11) (**Table 3**). The first compared antibiotic use with placebo, the second compared single doses of antibiotics with multiple doses, and the third compared 3 doses of antibiotics with multiple doses. We found no randomized trials that examined the timing of antibiotic administration, but we found one large case series involving patients undergoing elective surgery (12) (**Table 3**).

Meta-analysis of seven studies (60–66) that compared antibiotic use with placebo showed a 44% risk reduction in postoperative infection for the antibiotic group. Four studies (64, 67–69) compared multiple doses (range, 2 to 10 doses) with a single dose of antibiotics given immediately before surgery. There was a trend toward a reduction in postoperative infection in the multiple-dose group. A third meta-analysis summarized two studies (68, 70) that compared 3 doses of antibiotics with multiple doses. No significant differences were seen in infection rates between the two groups. First- and second-generation cephalosporins were used in most of the studies.

Table 2. Summary of Evidence

Subject	Recommendation	Study (Reference)	Strength of Evidence*
Surgical timing	Surgical repair should be undertaken within 24–48 hours in medically stable patients	Parker and Pryor (6); Bredahl et al. (7); Davis et al. (8); Rogers et al. (9); Zuckerman et al. (10)	3.3
Prophylactic antibiotics	All patients should receive prophylactic antibiotics	March et al. (11)	1
	The first antibiotic dose should be given 0–2 hours before surgery	March et al. (11)	1
	Antibiotics should be continued for 24 hours	Classen et al. (12)	3.3
Thromboembolic prophylaxis	All patients should receive low-molecular-weight or low-dose heparin unless it is contraindicated	Collins et al. (13); Lassen et al. (14); Gent et al. (15); Morris and Mitchell (16); Gerhart et al. (17); Pini et al. (18); Feldman et al. (19); Berqvist et al. (20, 21)	1
	Patients at high risk for bleeding who cannot receive heparin should receive aspirin if it is not contraindicated	Oertli et al. (22); Antiplatelet Trialists' Collaboration (23)	1
	All patients should receive compression stockings	Fisher et al. (24)	2
Nutritional management	Protein supplementation should be considered in all patients with hip fracture	Tkatch et al. (25); Delmi et al. (26); Stableforth (27)	2
	Nocturnal enteral feeding should be considered for patients with moderate to severe malnutrition	Bastow et al. (28)	2
Urinary tract management	Indwelling catheters should be removed within 24 hours of surgery, and patients should be managed by straight catheterization	Skelly et al. (29); Michelson et al. (30)	2
Delirium	Electrolyte levels should be followed and maintained within normal limits	Foreman (31); Francis et al. (32); Inouye and Charpentier (33); Marcantonio et al. (34)	3.2
	Use of sedative–hypnotic and anticholinergic medications should be minimized	Rogers et al. (35); Foreman (31); Francis et al. (32); Schor et al. (36)	3.2
	Supportive reorientation and environmental manipulation should be used	Williams et al. (37); Gustafson et al. (38)	3.1
Rehabilitation	Early mobilization can be done safely, but the benefits of this approach have yet to be conclusively shown	Cameron et al. (39); Zuckerman et al. (40); Stromqvist et al. (41); Arnold (42); Jarnlo (43); Ceder et al. (44); Karumo (45)	3.3
	Interdisciplinary rehabilitation should be undertaken whenever possible	Kennie et al. (46); Applegate et al. (47)	2
	Patients should receive at least two physical therapy sessions per day	Guccione et al. (48); Magaziner et al. (3)	3.2
Assessment of falls	Exercise and balance training should be undertaken in ambulatory patients after hip fracture	Province et al. (49)	1
	Interventions directed at specific risk factors may help prevent future falls	Wagner et al. (50); Tinetti et al. (51); Rubenstein et al. (52); Hornbrook et al. (53)	2

* 1 = Evidence obtained from a systematic review of relevant randomized, controlled trials; 2 = evidence obtained from at least one properly designed randomized, controlled trial; 3.1 = evidence obtained from well-designed controlled trials without randomization; 3.2 = evidence obtained from well-designed cohort or case–control analytic studies, preferably from more than one center or research group; 3.3 = evidence obtained from multiple time series with or without the intervention; 4 = opinions of respected authorities, based on clinical experience, descriptive studies, or reports of expert committees.

Table 3. Dose and Timing of Prophylactic Antibiotics

Study (Reference)	Study Type	Studies Included	Patients	Comparison Group	Odds Ratio (95% CI)
		n			
March et al. (11)	Meta-analysis	7	1816	Placebo (n = 888) compared with one or more antibiotic doses (n = 928)	0.56 (0.38–0.83)
March et al. (11)	Meta-analysis	4	2215	Single doses (n = 656) compared with multiple doses (n = 1559)	0.60 (0.18–2.02)
March et al. (11)	Meta-analysis	2	1136	Three doses (n = 561) compared with multiple doses (n = 575)	1.14 (0.53–2.34)
Classen et al. (12)	Cohort study	-	2847*	Antibiotics <2 hours before surgery (control group, n = 1708)	0
				Antibiotics 2–24 hours before surgery (n = 369)	6.7 (2.9–14.7)
				Antibiotics <3 hours after surgery (n = 282)	2.4 (0.9–7.9)
				Antibiotics 3–24 hours after surgery (n = 488)	5.8 (2.6–12.3)

* Elective surgery patients.

The only study that addressed optimal timing of antibiotic administration was a cohort study of 2847 elective procedures (12). In this study, wound infection rates were lowest when antibiotics were administered 0 to 2 hours before surgery.

Considerable evidence from 11 randomized trials (60–70) supports the use of prophylactic antibiotics (first- and second-generation cephalosporins) in patients with hip fracture. Antibiotics seem to reduce the risk for deep-wound infections by approximately 44%, and therapy should probably be continued for 24 hours (that is, about 3 doses should be given). Published data suggest that antibiotics should be administered 0 to 2 hours before surgery.

Thromboembolic Prophylaxis

Venous thromboembolism is a substantial cause of postoperative morbidity and mortality in patients with hip fracture. Despite a clear rationale for prophylaxis and clinical evidence of efficacy, use of prophylaxis is not universal, largely because of questions about which agent is the safest and most effective (71).

We identified three meta-analyses (13, 14, 23) in which patients with hip fracture were examined and an additional 10 randomized, controlled trials in which prophylactic thromboembolic agents in hip fracture were examined (**Table 4**). One of the meta-analyses compared low-dose heparin with placebo, one compared low-molecular-weight heparin with placebo or low-dose heparin, and the third compared aspirin with no treatment (23). We found no data on the duration of prophylaxis.

The studies reviewed strongly support the use of thromboembolic prophylaxis, but which agent is optimal is less clear. Low-dose heparin has been the agent most frequently studied in hip fracture and was associated with a reduction of about 60% in deep venous thromboses in one meta-analysis (13) (**Table 4**). Low-molecular-weight heparin has also been evaluated by meta-analysis and was shown to produce a similar reduction in deep venous thrombosis (14) (**Table 4**). The latter meta-analysis also pooled data from four studies that compared low-molecular-weight heparin with low-dose heparin and found no significant differences between the two agents for development of deep venous thrombosis. Low-dose heparin seems to proportionately increase the risk for major bleeding episodes by about 30% compared with placebo, but the actual percentage increase is small (overall rates, 3.5% in the heparin groups compared with 2.9% in the placebo groups) (13). In most studies, heparin therapy was initiated on hospital admission.

The use of aspirin as prophylaxis was examined in one meta-analysis of 10 orthopedic trauma trials, 9 of which included only patients with hip fracture and 1 of which included patients with hip and pelvic fractures (23) (**Table 4**). Aspirin was found to significantly reduce the risk for deep venous thrombosis and pulmonary embolism. However, when aspirin was compared with low-molecular-weight heparin for prevention of deep venous thrombosis in one recent trial (15), low-molecular-weight heparin resulted in a relative risk reduction of 37% and no significant difference in bleeding complications was seen.

Several other prophylactic agents have been evaluated (**Table 4**). Low-dose warfarin (prothrombin time 1.5 times that of control) was compared with placebo in two studies (16, 72) and with low-molecular-weight heparin in one study (17). Warfarin seems to confer a reduction in risk for deep venous thrombosis similar to that conferred by heparin, although the one study that compared low-molecular-weight heparin and warfarin directly suggests that low-molecular-weight heparin may be more efficacious (17). The use of dextran for deep venous thrombosis prophylaxis was evaluated in five trials (18–22), and this agent seems to be as efficacious as low-dose heparin (18, 20) or aspirin (19) but is probably less efficacious than low-molecular-weight heparin (19, 21, 22). Pneumatic compression devices seem to reduce the incidence of deep venous thrombosis compared with no treatment (24).

Strong evidence supports the use of low-dose heparin or low-molecular-weight heparin as prophylaxis for deep venous thrombosis starting at hospital admission. The latter agent is probably slightly more effective but is more expensive. Aspirin seems to have some benefit (but to a lesser extent) and may be considered in patients at high risk for hemorrhagic complications. Several studies support the use of low-dose warfarin; however, the required international normalized ratio [INR] monitoring and risk for over- or underanticoagulation are potential drawbacks. Nonetheless, some patients may prefer weekly monitoring of the INR to twice-daily injections of heparin or low-molecular-weight heparin. Compression stockings seem to impart benefit with negligible risk and should be used. Future research should determine the optimal duration of prophylactic anticoagulation and the cost-effectiveness of low-molecular-weight heparin compared with that of other prophylactic thromboembolic regimens.

Nutritional Management

Malnutrition is associated with increased surgical morbidity and mortality (73). It has been reported that as many as 20% of patients experiencing hip fracture are severely malnourished (74). Interventions that improve nutritional status may therefore improve outcome and decrease complications.

We identified four randomized, controlled trials of nutritional supplementation in patients undergoing surgery for hip fracture. Three examined oral protein supplementation (25–27), and one examined nocturnal nasogastric tube feeding (28).

Stableforth (27) compared patients with hip frac-

Table 4. Efficacy of Thromboembolic Prophylaxis on Prevention of Deep Venous Thrombosis*

Study (Reference)	Study Type	Studies Included	Patients	Comparison Groups	Odds Ratio (95% CI)	*P* Value
		n				
LMWH or LDH						
Collins et al. (13)	Meta-analysis	8	623	Placebo (4 studies, 183 patients) or open-label heparin (4 studies, 120 patients) compared with LDH (8 studies, 320 patients)	0.36	<0.05
Lassen et al. (14)	Meta-analysis	2	175	Placebo (92 patients) compared with LMWH (83 patients)	0.42 (0.23–0.77)	
Lassen et al. (14)	Meta-analysis	4	377	LDH (187 patients) compared with LMWH heparin (190 patients)	0.77 (0.46–1.29)	
Aspirin						
Antiplatelet Trialists' Collaboration (23)	Meta-analysis	10	898	Aspirin (454 patients) compared with no therapy (444 patients)	0.69 0.40 for PE	>0.02 <0.05
Gent et al. (15)	RCT	–	251	LMWH (125 patients) compared with aspirin (126 patients)	0.37 (0.37–0.597)	
Low-dose warfarin						
Powers et al. (72)	RCT	–	194	Warfarin (65 patients) compared with placebo (63 patients) or aspirin (66 patients)	0.24 for warfarin compared with placebo and 0.27 for aspirin compared with placebo for proximal DVT or PE	<0.001
Morris and Mitchell (16)	RCT	–	160	Warfarin (80 patients) compared with placebo (80 patients)	0.21	<0.01
Gerhart et al. (17)	RCT	–	263	Warfarin (131 patients) compared with LMWH (132 patients)	0.27	<0.01
Dextran						
Bergqvist et al. (20)	RCT	–	77	Dextran (27 patients), LDH (28 patients), and placebo (22 patients) compared	0.09 for dextran compared with placebo 0.18 for LDH compared with placebo Dextran and LDH did not differ	<0.05 <0.05
Pini et al. (18)	RCT	–	83	Dextran and aspirin (42 patients) compared with heparin and DHE (41 patients)	1.13	>0.2
Feldman et al. (19)	RCT	–	530	Dextran (338 patients) compared with aspirin (192 patients)	0.56	>0.05
Bergqvist et al. (21)	RCT	–	289	Dextran (146 patients) compared with LMWH (143 patients)	0.25 for LMWH	<0.001
Oertli et al. (22)	RCT	–	216	Dextran (103 patients) compared with LMWH (113 patients)	0.49 for LMWH	<0.005
Compression stockings						
Fisher et al. (24)	RCT	–	231	Compression devices (110 patients) compared with no treatment (121 patients)	0.31	<0.05

* DHE = dihydroergotamine; DVT = deep venous thrombosis; LDH = low-dose heparin; LMWH = low-molecular-weight heparin; PE = pulmonary embolism.

ture randomly allocated to protein supplementation with those allocated to usual care; significantly improved nitrogen and calorie balance was reported in the group that received supplementation. Delmi (26) and Tkatch (25) and their associates randomly assigned patients with hip fracture to receive protein supplementation or usual care (26) or placebo (25) on admission to the orthopedic service. Patients who received protein supplementation had significantly more favorable long-term outcomes at 6 months (none or only one minor complication), significantly higher albumin levels, and significantly shorter overall lengths of stay than patients who did not receive supplementation.

Bastow and coworkers (28) examined the effect of nocturnal nasogastric tube feeding in 122 patients at increased risk for nutritional compromise (arm and trifold skin circumference <1 SD below the mean for home and hospitalized elderly patients [75]). Patients were randomly assigned to receive usual care or nocturnal tube feedings within 5 days of admission. Mortality in the two groups did not differ significantly, but the study lacked statistical power to detect this difference. Very thin patients had a significant reduction in overall length of stay and had significant increases in weight (mean gain, 4.2 kg; $P < 0.01$) compared with controls. Patients who received tube feedings achieved independent mobility significantly faster than patients who did not receive tube feedings. One fifth of patients could not tolerate the nocturnal feedings.

Oral protein supplementation seems to be beneficial in reducing minor postoperative complications, preserving body protein stores, and reducing overall length of stay. Patients with evidence of moderate to severe malnutrition may benefit from nocturnal enteral tube feeding if they can tolerate it.

Urinary Tract Management

Urinary retention, incontinence, and urinary tract infections are commonly seen after surgery in patients with hip fracture (76). Because of the frequency of postoperative bladder problems, successful strategies to reduce voiding problems may decrease morbidity.

We identified two randomized, controlled trials of urinary bladder management in patients undergoing orthopedic surgery (29, 30). One study included patients with recent hip fracture, and the other included patients undergoing hip or knee replacement. Michelson and colleagues (30) randomly assigned 100 patients with knee or hip replacement to have their indwelling urinary catheters removed immediately after surgery or the morning after surgery. The group that had the catheter removed the morning after surgery had significantly lower rates of urinary retention. Skelly and associates (29) randomly assigned 67 patients with hip fracture to receive an indwelling catheter for 48 hours after surgery followed by scheduled intermittent straight catheterization or scheduled intermittent straight catheterization immediately after surgery. Spontaneous voiding occurred significantly earlier in the group that received intermittent catheterization immediately after surgery. The incidence of urinary tract infections did not significantly differ between the control and intervention groups in either study.

Few studies have examined the management of urinary catheters in hip fracture. The management of catheters may be affected by previous level of continence, mobility, and availability of nursing staff. Whenever possible, indwelling catheters should probably be removed within 24 hours of surgery, and patients should be managed with scheduled intermittent straight catheterization.

Delirium

Delirium occurs in up to 61% of patients with hip fracture (77). Despite its prevalence, delirium is often unrecognized or misdiagnosed (78). Delirium in hospitalized patients has been shown to increase length of stay, risk for complications, mortality, and institutionalization (79–83). Most patients who develop delirium have some persistent symptoms up to 6 months later. In patients with hip fracture, delirium may have an additional effect on functional outcome by interfering with rehabilitation activities and delaying return to weight bearing.

For this review, we focused on three types of investigations. First, we identified studies in which multivariate methods were used to identify risk factors that, if modified, may prevent delirium; 13 studies met these criteria (31–36, 77, 83–88). Second, because treatment of the underlying cause is a cornerstone of the management of delirium, we identified studies that systematically described the frequency of different causes of this syndrome. We found three case series (32, 89, 90). Finally, we identified studies that focused on the prevention and management of delirium in patients with hip fracture. We found two nonrandomized studies that examined supportive treatment of delirium (37, 38).

With regard to baseline risk factors for delirium, the findings seem fairly consistent across most studies. Advanced age, history of cognitive impairment, greater severity of illness, and history of alcohol use seem to increase the risk for confusion in hospitalized medical and surgical patients. In the two studies of patients with hip fracture, only age, dementia, and prefracture functional status predicted development of delirium (37, 77). Precipitating risk factors have been more difficult to identify and, with few exceptions, a clear understanding of the iatrogenic conditions that increase risk for delirium in elderly patients has not yet emerged. Although many risk factors have been proposed (such as metabolic disturbances, dehydration, alcohol withdrawal, urinary retention, changes in environment, psychosocial factors, and medications [91]), only electrolyte imbalances and some classes of medication (opioids, sedative–hypnotics, and anticholinergics) have been consistently identified as precipitating factors in prospective trials, and even these factors are not consistent across studies. No precipitating factors were identified in the two studies of patients with hip fracture, but these studies had limited power to identify such factors (37, 38).

As for the cause of delirium, we could not identify any studies that focused exclusively on patients with hip fracture. We identified three case series (32, 89, 90) that examined this issue in medical and surgical patients; only one had specific criteria for assigning causes. These studies suggest that the most common causes of delirium are fluid and electrolyte imbalances, infection, metabolic disorders, drug toxicity, and sensory and environmental problems.

Management of delirium has been based largely on clinical experience because few systematic and controlled studies have been done (91). We identified two nonrandomized studies involving patients with hip fracture. Williams and coworkers (37) did a time-sequence trial of pre- and postoperative nursing interventions (such as environmental manipulation, reorientation, and reassurance) in patients with hip fracture. The incidence of delirium was 44% in the treatment group and 52% in the control group. Gustafson and associates (38) compared 103 patients who received treatment with 111 historical controls admitted 2 to 5 years before the intervention cohort. The intervention in this study consisted of pre- and postoperative geriatric assessments, oxygen therapy for hypoxia, early surgery (done as soon as patients were medically stable), and aggressive treatment of perioperative decreases in blood pressure. The incidence of delirium was 61% in the controls and 48% in the treatment group. Patients in the treatment group were less likely than controls to be confused for more than 7 days (9% compared with 28%) and had a shorter length of stay (11.6 days compared with 17.4 days). The individual contributions of each component of the intervention to reduction in delirium are not known.

In summary, although many cohort studies have examined the risk factors for delirium, most analyses have not specifically focused on patients with hip fracture and many studies have lacked adequate statistical power. Nevertheless, the assembled studies indicate numerous recurring, potentially modifiable risk factors for delirium, including electrolyte and metabolic laboratory abnormalities, medications with psychoactive properties, and infection. Studies that have systematically examined causes of delirium have been small. However, their findings indicate several common causes, including fluid and electrolyte abnormalities, infection, drug toxicity, metabolic disorders, and low cerebral perfusion. Environmental manipulation and supportive reorientation seem to reduce the incidence of delirium and benefit acutely delirious patients. More research on the optimal management of delirium is needed.

Rehabilitation

Rehabilitative services for patients with hip fracture may include limb and joint mobilization and progressive exercises, physical and occupational therapy to regain mobility and independence in activities of daily living, physician supervision of therapy, psychological counseling, social work, restorative nursing services, and recreational services. For this review, we focused on selected aspects of rehabilitation that are particularly salient to the internist; we recognize that rehabilitation is a responsibility shared with the surgeon who, depending on the fracture and type of surgery, may have specific recommendations about mobilization and weight bearing. We address the value of early mobilization, intensified interdisciplinary rehabilitation approaches, and intensity and frequency of therapy.

We identified several reports of programs that used early mobilization or early weight-bearing policies. From these reports, we excluded studies, primarily from the 1960s and 1970s, that reviewed the effects of "early weight-bearing" initiated many days or weeks after the perioperative period; we focused instead on studies that reported on mobilization in the first 24 to 48 hours. We identified one randomized trial (39) that included early mobilization as part of a larger program of accelerated rehabilitation; we also identified many trials in which all patients received early mobilization (in the first 24 to 48 hours) (40–45, 92–97). In the case of intensified interdisciplinary rehabilitation programs, we identified four randomized trials (46, 47, 98, 99). For the intensity and frequency of physical therapy, we identified two small randomized trials (45, 99) and two cohort studies that attempted to control for potential confounding between patient characteristics and receipt of services (3, 48).

The randomized trial that evaluated early mobilization (usually within 24 hours of surgery) did so as part of a program that included early discharge from the hospital and a comprehensive rehabilitation program during and after hospitalization (39). Although that trial found no differences in the physical independence of the 252 patients at 4 months, it showed that so-called accelerated rehabilitation could reduce health care costs. Other studies (40–45, 92–97) showed that policies on early mobilization from the first day after surgery can be implemented with acceptable rates of complications (40–42), discharge destination (40, 44), functional outcome (40, 43, 45), and mortality (42, 44).

Of the four relatively small randomized trials that evaluated the benefits of geriatric interdisciplinary rehabilitation (46, 47, 98, 99), two found no differences in functional outcome (99), mortality, or placement (98). However, two studies found positive effects associated with these programs. In a study of 112 patients, Kennie and colleagues (46) reported improved functional status and found that patients were more likely to be discharged to their own homes than to a nursing home after interdisciplinary rehabilitation. In addition, a randomized trial of geriatric assessment and rehabilitation in which hip fracture was the most common diagnosis (occurring in 18% of the patients) found that geriatric rehabilitation improved the patient's likelihood of returning to the community (47).

Two randomized trials evaluated intensified physical therapy (that is, therapy sessions twice per day rather than once per day or supplemental individualized educational sessions) (45, 99). Both trials failed to show a benefit in functional outcomes; however, both were small. Therefore, we sought additional evidence of efficacy from cohort studies that attempted to control for potential confounding between patient characteristics and receipt of services. In a cohort study of 162 hospitalized patients, Guccione and associates (48) found that more than one physical therapy session per day was associated with improved functional outcome after adjustment for age, prefracture ambulation, and length of stay. In a study of 536 patients, Magaziner and coworkers (3) reported that the number of physical therapy sessions (after adjustment for prefracture and other hospital care variables) was associated with improved physical independence at 1 year but did not affect walking ability or ability to perform instrumental activities of daily living.

In summary, the data suggest that early mobilization is safe in selected patients. However, data are lacking on the potential benefits of early mobilization. In the case of interdisciplinary rehabilitation featuring geriatric assessment, randomized trials suggest that these programs can improve functional outcome and increase the likelihood that patients will return to the community. These trials, however, were small and were limited to programs with personnel who have a special interest in orthogeriatrics. For physical therapy services, cohort studies that have adjusted for potential confounders suggest that the frequency of physical therapy probably has an important effect on outcome and that more than one session per day is probably beneficial.

Assessment of Falls

Patients with hip fracture have an increased risk for subsequent fracture (100). Interventions to reduce the likelihood and number of subsequent falls may therefore have beneficial effects on outcome.

We identified seven randomized trials (50–53, 101–103) and one preplanned meta-analysis (49) of clinical and social interventions to reduce falls. None of the studies specifically targeted patients with hip fracture. Two of the seven studies (51, 52) focused on patients at risk for falling on the basis of other factors. Four (50, 53, 102, 103) focused on older persons in the community who were otherwise not screened for risk for falls, and one focused on frail nursing home residents (101). A meta-analysis (49) included eight trials, two of which are cited above (51, 101), and examined the effect of exercise and balance on fall prevention.

The five studies (50, 53, 101–103) that focused on persons previously unscreened for risk for falling randomly assigned nursing home residents (101), senior centers, or households to such interventions as low-intensity exercises, counseling on risk-factor reduction, and efforts to identify and correct environmental hazards. Two of the studies (50, 53) showed that the intervention slightly reduced the risk for falling but not the risk for fractures or falls requiring medical attention. Interventions that targeted older persons at risk for falling were more efficacious. Rubenstein and colleagues (52) randomly assigned ambulatory nursing home residents to receive usual care or detailed clinical and environmental assessments within 1 week of the fall. The intervention did not significantly reduce the risk for subsequent falls, but the intervention group was hospitalized less frequently over the next 2 years. Tinetti and coworkers (51) identified community-dwelling older persons with specific risk factors for falling (such as postural hypotension or difficulty in transferring) and randomly assigned them to receive social visits or a multifactorial intervention that featured medication adjustment, behavioral instruction, and exercise activities targeted to the person's risk factors. This intervention reduced the risk for falling (relative risk, 0.69 [95% CI, 0.52 to 0.90]) and the prevalence of targeted risk factors. Province and associates (49) did a meta-analysis of eight trials involving diverse patient populations and several different interventions, all of which included an exercise component. Treatment arms that included the exercise component showed an adjusted incidence rate for falls of 0.90 (CI, 0.81 to 0.99), and an adjusted incidence rate for falls of 0.83 (CI, 0.70 to 0.98) was seen for groups receiving treatment that included balance training compared with controls. No exercise component was significant for injurious falls, but power was low to detect this outcome.

These studies suggest that interventions to reduce the incidence of falls are more likely to be beneficial if they focus on persons at risk for falls and target specific risk factors or behaviors. Exercise and balance training also seem somewhat effective in decreasing risk for falls. Because persons who have sustained hip fractures are at higher risk for subsequent falls, these findings may be generalizable to this population.

Conclusions

Hip fracture is a common condition that results in death or substantial loss of function for more than 150 000 persons annually in the United States. Furthermore, the annual number of hip fractures is expected to double by the year 2040 (104, 105). Our literature review suggests that evidence-based medical care can improve clinical outcomes of patients with hip fracture (**Table 2**). We identified processes of medical care for which the data are unambiguous (such as prophylactic antibiotics and thromboembolic prophylaxis) and others for which the data are less clear and for which more research is needed (such as management of delirium, prevention of falls, duration of thromboembolic prophylaxis, and the cost-effectiveness of low-molecular-weight heparin compared with that of other agents). We believe that our recommendations will enhance the ability to predict and manage the common complications of hip fracture, improve function and quality of life, and improve the quality of medical care afforded to patients with hip fracture.

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References

1. **Barrett-Connor E.** The economic and human cost of osteoporotic fracture. Am J Med. 1995;98:3S-8S.
2. **Lu-Yao GL, Baron JA, Barrett JA, Fischer ES.** Treatment and survival among elderly Americans with hip fractures: a population-based study. Am J Pub Health. 1994;84:1287-91.
3. **Magaziner J, Simonsick EM, Kashner TM, Hebel JR, Kenzora JE.** Predictors of functional recovery one year following hospital discharge for hip fracture: a prospective study. J Gerontol. 1990;45:M101-7.
4. **Zuckerman JD.** Hip fracture. N Engl J Med. 1996;334:1519-25.
5. **U.S. Preventive Services Task Force.** Guide to clinical preventive services: an assessment of the effectiveness of 169 interventions. Baltimore: Williams & Wilkins; 1989.
6. **Parker MJ, Pryor GA.** The timing of surgery for proximal femoral fractures. J Bone Joint Surg [Br]. 1992;74:203-5.
7. **Bredahl C, Nyholm B, Hindsholm KB, Mortensen JS, Olesen AS.** Mortality after hip fracture: results of operation within 12 h of admission. Injury. 1992;23:83-6.
8. **Davis FM, Woolner DF, Frampton C, Wilkinson A, Grant A, Harrison RT, et al.** Prospective, multi-centre trial of mortality following general or spinal anaesthesia for hip fracture surgery in the elderly. Br J Anaesth. 1987;59:1080-8.
9. **Rogers FB, Shackford SR, Keller MS.** Early fixation reduces morbidity and mortality in elderly patients with hip fractures from low-impact falls. J Trauma. 1995;39:261-5.
10. **Zuckerman JD, Skovron ML, Koval KJ, Aharonoff G, Frankel VH.** Postoperative complications and mortality associated with operative delay in older patients who have a fracture of the hip. J Bone Joint Surg Am. 1995;77:1551-6.
11. **March L, Chamberlain A, Cameron I, Cumming R, Kurrle S, Finnegan T, et al.** Prevention, treatment, and rehabilitation of fractured neck of femur. St. Leonards, Australia: Public Health Unit, Northern Sydney Area Health Service; 1996.
12. **Classen DC, Evans RS, Pestotnik SL, Horn SD, Menlove RL, Burke JP.** The timing of prophylactic administration of antibiotics and the risk of surgical-wound infection. N Engl J Med. 1992;326:281-6.
13. **Collins R, Scrimgeour A, Yusuf S, Peto R.** Reduction in fatal pulmonary embolism and venous thrombosis by perioperative administration of subcutaneous heparin. Overview of results of randomized trials in general, orthopedic, and urologic surgery. N Engl J Med. 1988;318:1162-73.
14. **Lassen MR, Borris LC, Christiansen HM, Schott P, Olsen AD, Sorensen JV, et al.** Clinical trials with low molecular weight heparins in the prevention of postoperative thromboembolic complications: a meta-analysis. Sem Thromb Hemost. 1991;17:284-90.
15. **Gent M, Hirsh J, Ginsberg JS, Powers PJ, Levine MN, Geerts WH, et al.** Low-molecular-weight heparinoid orgaran is more effective than aspirin in the prevention of venous thromboembolism after surgery for hip fracture. Circulation. 1996;93:80-4.
16. **Morris GK, Mitchell JR.** Preventing venous thromboembolism in elderly patients with hip fractures: studies of low-dose heparin, dipyridamole, aspirin, and flurbiprofen. Br Med J. 1977;1:535-7.
17. **Gerhart TN, Yett HS, Robertson LK, Lee MA, Smith M, Salzman EW.** Low-molecular-weight heparinoid compared with warfarin for prophylaxis of deep-vein thrombosis in patients who are operated on for fracture of the hip. A prospective, randomized trial. J Bone Joint Surg [Am]. 1991;73:494-502.
18. **Pini M, Spadini E, Carluccio L, Giovanardi C, Magnani E, Ugolotti U, et al.** Dextran/aspirin versus heparin/dihydroergotamine in preventing thrombosis after hip fracture. J Bone Joint Surg [Br]. 1985;67:305-9.
19. **Feldman DS, Zuckerman JD, Walters I, Sakales SR.** Clinical efficacy of aspirin and dextran for thromboprophylaxis in geriatric hip fracture patients. J Orthop Trauma. 1993;7:1-5.
20. **Bergqvist D, Efsing HO, Hallbook T, Hedlund T.** Thromboembolism after elective and post-traumatic hip surgery—a controlled prophylactic trial with dextran 70 and low-dose heparin. Acta Chir Scand. 1979;145:213-8.
21. **Bergqvist D, Kettunen K, Fredin H, Fauno P, Suomalainen O, Soimakallio S, et al.** Thromboprophylaxis in patients with hip fractures: a prospective, randomized, comparative study between Org 10172 and dextran 70. Surgery. 1991;109:617-22.
22. **Oertli D, Hess P, Durig M, Laffer U, Fridrich R, Jaeger K, et al.** Prevention of deep vein thrombosis in patients with hip fractures: low molecular weight heparin versus dextran. World J Surg. 1992;16:980-4.
23. Collaborative overview of randomised trials of antiplatelet therapy—III: Reduction in venous thrombosis and pulmonary embolism by antiplatelet prophylaxis among surgical and medical patients. Antiplatelet Trialists' Collaboration. BMJ. 1994;308:235-46.
24. **Fisher CG, Blachut PA, Salvian AJ, Meek RN, O'Brien PJ.** Effectiveness of pneumatic leg compression devices for the prevention of thromboembolic disease in orthopaedic trauma patients: a prospective, randomized study of compression alone versus no prophylaxis. J Orthop Trauma. 1995;9:1-7.
25. **Tkatch L, Rapin CH, Rizzoli R, Slosman D, Nydegger V, Vasey H, et al.** Benefits of oral protein supplementation in elderly patients with fracture of the proximal femur. J Am Coll Nutr. 1992;11:519-25.
26. **Delmi M, Rapin CH, Bengoa JM, Delmas PD, Vasey H, Bonjour JP.** Dietary supplementation in elderly patients with fractured neck of the femur. Lancet. 1990;335:1013-6.
27. **Stableforth PG.** Supplement feeds and nitrogen and calorie balance following femoral neck fracture. Br J Surg. 1986;73:651-5.
28. **Bastow MD, Rawlings J, Allison SP.** Benefits of supplementary tube feeding after fractured neck of femur: a randomised controlled trial. Br Med J (Clin Res Ed). 1983;287:1589-92.
29. **Skelly JM, Guyatt GH, Kalbfleisch R, Singer J, Winter L.** Management of urinary retention after surgical repair of hip fracture. CMAJ. 1992;146:1185-9.

30. **Michelson JD, Lotke PA, Steinberg ME.** Urinary-bladder management after total joint-replacement surgery. N Engl J Med. 1988;319:321-6.
31. **Foreman M.** Confusion in the hospitalized elderly: incidence, onset, and associated factors. Res Nurs Health. 1989;12:21-9.
32. **Francis J, Martin D, Kapoor WN.** A prospective study of delirium in hospitalized elderly. JAMA. 1990;263:1097-101.
33. **Inouye SK, Charpentier PA.** Precipitating factors for delirium in hospitalized elderly persons. Predictive model and interrelationship with baseline vulnerability. JAMA. 1996;275:852-7.
34. **Marcantonio ER, Goldman L, Mangione CM, Ludwig LE, Muraca B, Haslauer CM, et al.** A clinical prediction rule for delirium after elective noncardiac surgery. JAMA. 1994;271:134-9.
35. **Rogers MP, Liang MH, Daltroy LH, Eaton H, Peteet J, Wright E, et al.** Delirium after elective orthopedic surgery: risk factors and natural history. Int J Psychiatry Med. 1989;19:109-21.
36. **Schor JD, Levkoff SE, Lipsitz LA, Reilly CH, Cleary PD, Rowe JW, et al.** Risk factors for delirium in hospitalized elderly. JAMA. 1992;267:827-31.
37. **Williams MA, Campbell EB, Raynor WJ, Mlynarczyk SM, Ward SE.** Reducing acute confusional states in elderly patients with hip fractures. Res Nurs Health. 1985;8:329-37.
38. **Gustafson Y, Brannstrom B, Berggren D, Ragnarsson JI, Sigaard J, Bucht G, et al.** A geriatric-anesthesiologic program to reduce acute confusional states in elderly patients treated for femoral neck fractures. J Am Geriatr Soc. 1991;39:655-62.
39. **Cameron ID, Lyle DM, Quine S.** Cost effectiveness of accelerated rehabilitation after proximal femoral fracture. J Clin Epidemiol. 1994;47:1307-13.
40. **Zuckerman JD, Sakales SR, Fabian DR, Frankel VH.** Hip fractures in geriatric patients. Results of an interdisciplinary hospital care program. Clin Orthop. 1992;274:213-25.
41. **Stromqvist B, Hansson LI, Nilsson LT, Thorngren KG.** Hook-pin fixation in femoral neck fractures. A two-year follow-up study of 300 cases. Clin Orthop. 1987;218:58-62.
42. **Arnold WD.** The effect of early weight-bearing on the stability of femoral neck fractures treated with Knowles pins. J Bone Joint Surg [Am]. 1984;66:847-52.
43. **Jarnlo GB.** Hip fracture patients. Background factors and function. Scand J Rehabil Med Suppl. 1991;24:1-31.
44. **Ceder L, Stromqvist B, Hansson LI.** Effects of strategy changes in the treatment of femoral neck fractures during a 17-year period. Clin Orthop. 1987;218:53-7.
45. **Karumo I.** Intensive physical therapy after fractures of the femoral shaft. Ann Chir Gynaecol. 1977;66:278-83.
46. **Kennie DC, Reid J, Richardson IR, Kiamari AA, Kelt C.** Effectiveness of geriatric rehabilitative care after fractures of the proximal femur in elderly women: a randomised clinical trial. BMJ. 1988;297:1083-6.
47. **Applegate WB, Miller ST, Graney MJ, Elam JT, Burns R, Akins DE.** A randomized, controlled trial of a geriatric assessment unit in a community rehabilitation hospital. N Engl J Med. 1990;322:1572-8.
48. **Guccione AA, Fagerson TL, Anderson JJ.** Regaining functional independence in the acute care setting following hip fracture. Phys Ther. 1996;76:818-26.
49. **Province MA, Hadley EC, Hornbrook MC, Lipsitz LA, Miller JP, Mulrow CD, et al.** The effects of exercise on falls in elderly patients. A preplanned meta-analysis of the FICSIT Trials. Frailty and Injuries: Cooperative Studies of Intervention Techniques. JAMA. 1995;273:1341-7.
50. **Wagner EH, LaCroix AZ, Grothaus L, Leveille SG, Hecht JA, Artz K, et al.** Preventing disability and falls in older adults: a population-based randomized trial. Am J Public Health. 1994;84:1800-6.
51. **Tinetti ME, Baker DI, McAvay G, Claus EB, Garrett P, Gottschalk M, et al.** A multifactorial intervention to reduce the risk of falling among elderly people living in the community. N Engl J Med. 1994;331:821-7.
52. **Rubenstein LZ, Robbins AS, Josephson KR, Schulman BL, Osterweil D.** The value of assessing falls in an elderly population. A randomized clinical trial. Ann Intern Med. 1990;113:308-16.
53. **Hornbrook MC, Stevens VJ, Wingfield DJ, Hollis JF, Greenlick MR, Ory MG.** Preventing falls among community-dwelling older persons: results from a randomized trial. Gerontologist. 1994;34:16-23.
54. **Dolk T.** Operation in hip fracture patients—analysis of the time factor. Injury. 1990;21:369-72.
55. **Villar RN, Allen SM, Barnes SJ.** Hip fractures in healthy patients: operative delay versus prognosis. Br Med J (Clin Res Ed). 1986;293:1203-4.
56. **Holmberg S, Kalen R, Thorngren K.** Treatment and outcome of femoral neck fractures. An analysis of 2418 patients admitted from their own homes. Clin Orthop. 1987;218:42-52.
57. **Kenzora JE, McCarthy RE, Lowell JD, Sledge CB.** Hip fracture mortality. Relation to age, treatment, preoperative illness, time of surgery, and complications. Clin Orthop. 1984;186:45-56.
58. **Todd CJ, Freeman CJ, Camilleri-Ferrante C, Palmer CR, Hyder A, Laxton CE, et al.** Differences in mortality after fracture of hip: the east Anglian audit. BMJ. 1995;310:904-8.
59. **Perez JV, Warwick DJ, Case CP, Bannister GC.** Death after proximal femoral fracture—an autopsy study. Injury. 1995;26:237-40.
60. **Boyd RJ, Burke JF, Colton T.** A double-blind clinical trial of prophylactic antibiotics in hip fractures. J Bone Joint Surg [Am]. 1973;55:1251-8.
61. **McQueen MM, LittleJohn MA, Miles RS, Hughes SP.** Antibiotic prophylaxis in proximal femoral fracture. Injury. 1990;21:104-6.
62. **Hjortrup A, Sorensen C, Mejdahl S, Horsnaes M, Kjersgaard P.** Antibiotic prophylaxis in surgery for hip fractures. Acta Orthop Scand. 1990;61:152-3.
63. **Bodoky A, Neff U, Heberer M, Harder F.** Antibiotic prophylaxis with two doses of cephalosporin in patients managed with internal fixation for a fracture of the hip. J Bone Joint Surg Am. 1993;75:61-5.
64. **Buckley R, Hughes GN, Snodgrass T, Huchcroft SA.** Perioperative cefazolin prophylaxis in hip fracture surgery. Can J Surg. 1990;33:122-7.
65. **Tengve B, Kjellander J.** Antibiotic prophylaxis in operations on trochanteric femoral fractures. J Bone Joint Surg [Am]. 1978;60:97-9.
66. **Ericson C, Lindgren L, Lindberg L.** Cloxacillin in the prophylaxis of postoperative infections of the hip. J Bone Joint Surg [Am]. 1973;55:808-13, 843.
67. **Gatell JM, Garcia S, Lozano L, Soriano E, Ramon R, SanMiguel JG.** Perioperative cefamandole prophylaxis against infections. J Bone Joint Surg [Am]. 1987;69:1189-93.
68. **Garcia S, Lozano ML, Gatell JM, Soriano E, Ramon R, Sanmiguel JG.** Prophylaxis against infection. Single-dose cefonicid compared with multiple-dose cefamandole. J Bone Joint Surg [Am]. 1991;73:1044-8.
69. **Karachalios T, Lyritis GP, Hatzopoulos E.** Antibiotic prophylaxis in the surgical treatment of peritrochanteric fractures: a comparative trial between two cephalosporins. Chemotherapy. 1990;36:448-53.
70. **Hedstrom SA, Lidgren L, Sernbo I, Torholm C, Onnerfalt R.** Cefuroxime prophylaxis in trochanteric hip fracture operations. Acta Orthop Scand. 1987;58:361-4.
71. **Imperiale TF, Speroff T.** A meta-analysis of methods to prevent venous thromboembolism following total hip replacement. JAMA. 1994;271:1780-5.
72. **Powers PJ, Gent M, Jay RM, Julian DH, Turpie AG, Levine M, et al.** A randomized trial of less intense postoperative warfarin or aspirin therapy in the prevention of venous thromboembolism after surgery for fractured hip. Arch Intern Med. 1989;149:771-4.
73. **Patterson BM, Cornell CN, Carbone B, Levine B, Chapman D.** Protein depletion and metabolic stress in elderly patients who have a fracture of the hip. J Bone Joint Surg [Am]. 1992;74:251-60.
74. **Bastow M, Rawlings J, Allison SP.** Undernutrition, hypothermia, and injury in elderly women with fractured femur: an injury response to altered metabolism? Lancet. 1983;1:143-6.
75. **Vir SC, Love AH.** Anthropometric measurements in the elderly. Gerontology. 1980;26:1-8.
76. **Smith NK, Albazzaz MK.** A prospective study of urinary retention and risk of death after proximal femoral fracture. Age Ageing. 1996;25:150-4.
77. **Gustafson Y, Berggren D, Brannstrom B, Bucht G, Norberg A, Hansson LI, et al.** Acute confusional states in elderly patients treated for femoral neck fracture. J Am Geriatr Soc. 1988;36:525-30.
78. **Rummans TA, Evans JM, Krahn LE, Fleming KC.** Delirium in elderly patients: evaluation and management. Mayo Clin Proc. 1995;70:989-98.
79. **Cole M, Primeau F.** Prognosis of delirium in elderly hospital patients. CMAJ. 1993;149:41-6.
80. **Francis J, Kapoor WN.** Prognosis after hospital discharge of older medical patients with delirium. J Am Geriatr Soc. 1992;40:601-6.
81. **Levkoff SE, Evans DA, Liptzin B, Cleary PD, Lipsitz LA, Wetle TT, et al.** Delirium. The occurrence and persistence of symptoms among elderly hospitalized patients. Arch Intern Med. 1992;152:334-40.
82. **Murray AM, Levkoff SE, Wetle TT, Beckett L, Cleary PD, Schor JD, et al.** Acute delirium and functional decline in the hospitalized elderly patient. J Gerontol. 1993;48:M181-6.
83. **Rockwood K.** Delays in the discharge of elderly patients. J Clin Epidemiol. 1990;43:971-5.
84. **Williams MA, Campbell EB, Raynor WJ Jr, Musholt MA, Mlynarczyk SM, Crane LF.** Predictors of acute confusional states in hospitalized elderly patients. Res Nurs Health. 1985;8:31-40.
85. **Inouye SK, Viscoli CM, Horwitz RI, Hurst LD, Tinetti ME.** A predictive model for delirium in hospitalized elderly medical patients based on admission characteristics. Ann Intern Med. 1993;119:474-81.
86. **Jitapunkul S, Pillay I, Ebrahim S.** Delirium in newly admitted elderly patients: a prospective study. Q J Med. 1992;83:307-14.
87. **Pompei P, Foreman M, Rudberg MA, Inouye SK, Braund V, Cassel CK.** Delirium in hospitalized older persons: outcomes and predictors. J Am Geriatr Soc. 1994;42:809-15.
88. **Williams-Russo P, Urquhart BL, Sharrock NE, Charlson ME.** Post-operative delirium: predictors and prognosis in elderly orthopedic patients. J Am Geriatr Soc. 1992;40:759-67.
89. **Moses H 3d, Kaden I.** Neurologic consultations in a general hospital. Spectrum of iatrogenic disease. Am J Med. 1986;81:955-8.
90. **Purdie FR, Honigman B, Rosen P.** Acute organic brain syndrome: a review of 100 cases. Ann Emerg Med. 1981;10:455-61.
91. **Francis J.** Delirium in older patients. J Am Geriatr Soc. 1992;40:829-38.
92. **Skinner P, Riley D, Ellergy J, Beaumont A, Coumine R, Shafighian B.** Displaced subcapital fractures of the femur: a prospective randomized comparison of internal fixation, hemiarthroplasty and total hip replacement. Injury. 1989;20:291-3.
93. **Sorenson JL, Varmarken JE, Bomler J.** Internal fixation of femoral neck fractures. Dynamic hip and Gouffon screws compared in 73 patients. Acta Orthop Scand. 1992;63:288-92.
94. **Elmerson S, Andersson GB, Irstam L, Zetterberg C.** Internal fixation of femoral neck fracture. No difference between Rydell four-flanged nail and Gouffon's pin. Acta Orthop Scand. 1988;59:372-6.
95. **Olerud C, Rehnberg L, Hellquist E.** Internal fixation of femoral neck fractures. Two methods compared. J Bone Joint Surg [Br]. 1991;73:16-9.
96. **Nungu S, Olerud C, Rehnberg L.** Treatment of intertrochanteric fractures: comparison of Ender nails and sliding screw plates. J Orthop Trauma. 1991;5:452-7.

97. **Dalen N, Jacobsson B, Eriksson PA.** A comparison of nail-plate fixation and Ender's nailing in pertrochanteric fractures. J Trauma. 1988;28:4056.
98. **Gilchrist WJ, Newman RJ, Hamblen DL, Williams BO.** Prospective randomised study of an orthopaedic geriatric inpatient service. BMJ. 1988;297:1116-8.
99. **Jette AM, Harris BA, Cleary PD, Campion EW.** Functional recovery after hip fracture. Arch Phys Med Rehabil. 1987;68:735-40.
100. **Finsen V, Benum P.** The second hip fracture. An epidemiologic study. Acta Orthop Scand. 1986;57:431-3.
101. **Mulrow CD, Gerety MB, Kanten D, Cornell JE, DeNino LA, Chiodo L, et al.** A randomized trial of physical rehabilitation for very frail nursing home residents. JAMA. 1994;271:519-24.
102. **Reinsch S, Macrae P, Lachenbruch PA, Tobis JS.** Attempts to prevent falls and injury: a prospective community study. Gerontologist. 1992;32:450-6.
103. **Vetter NJ, Lewis PA, Ford D.** Can health visitors prevent fractures in elderly people? BMJ. 1992;304:888-90.
104. **Cummings SR, Kelsey JL, Nevitt MC, O'Dowd KJ.** Epidemiology of osteoporosis and osteoporotic fractures. Epidemiol Rev. 1985;7:178-208.
105. **Cummings SR, Rubin S, Black D.** The future of hip fractures in the United States. Numbers, costs, and potential effects of postmenopausal estrogen. Clin Orthop. 1990;252:163-6.