Anaesthesia for hip surgery in the elderly

Caroline R. Covert MD FRCPC, Gordon S. Fox MD FRCPC

Surgical repair of hip fracture and total hip arthroplasty are primarily performed on elderly patients. Patients presenting for hip fracture surgery have a high prevalence of preoperative medical problems and may require medical stabilization before surgery. Regional anaesthesia for hip fracture repair may be contraindicated due to perioperative pharmacologic prophylaxis for deep venous thrombosis. The use of regional anaesthesia increases the magnitude and frequency of hypotensive episodes when compared with general anaesthesia. Intraoperative blood losses, averaging 250–300 ml, are not affected by anaesthetic technique. Following hip fracture surgery under spinal anaesthesia, patients exhibit better oxygenation in the early postoperative period than those after general anaesthesia. The frequency of postoperative confusion is unrelated to anaesthetic technique. The incidence of deep venous thrombosis is reduced following spinal anaesthesia as compared with general anaesthesia. The one-month mortality rate, approximately eight per cent, is unrelated to anaesthetic technique. Spinal, epidural and general anaesthesia have been used successfully for total hip arthroplasty. Intraoperative blood loss of 0.5–1.5 litres is reduced with regional anaesthesia. General anaesthesia with controlled hypotension also significantly reduces blood loss. Intraoperative instability with hypoxaemia, hypotension and cardiac arrest may follow impaction of the femoral prosthesis and are related to absorption of acrylic cement monomers and pulmonary embolism of fat, air, and platelet-fibrin aggregates. Postoperative deep venous thrombosis is common and the incidence may be reduced with epidural anaesthesia. Operative mortality is less than one per cent and pulmonary embolism is the commonest cause of death. Data relating mortality to anaesthetic technique do not exist. Anaesthetic technique for hip fracture surgery does not appear to significantly alter morbidity or mortality. Regional anaesthesia for total hip arthroplasty reduces deep venous thrombosis, pulmonary embolism, and blood loss and may be the preferred technique, alone or in combination with general anaesthesia.

Key words
ANAESTHESIA: geriatric, orthopaedic.

From the Department of Anaesthesia, The Sir Mortimer B. Davis Jewish General Hospital, McGill University, Montreal, Quebec.

Address correspondence to: Dr. C. Covert, Department of Anaesthesia, Sir Mortimer B. Davis Jewish General Hospital, 3755 Cote Ste. Catherine Road, Montreal, Quebec H3T 1E2.

CAN J ANAESTH 1989 / 36: 3 / pp 311–9

Two common surgical procedures on the hip, repair of fractured proximal femur and total hip arthroplasty, are primarily performed on elderly patients.[1,2] As the number of elderly people in our society rises,[3] the number of patients requiring optimal anaesthetic care for hip surgery will increase. The following is a review of the anaesthetic considerations for hip surgery, emphasizing the effect of anaesthetic technique on perioperative morbidity and mortality.

Hip fracture

Patient population

Fractures of the hip are common, and place a significant burden on health care services.[4] The incidence increases with age[5] and is rising with the changing demographics of the Western World.[6] The mean age of patients sustaining fractured hips is 75–80 years.[7,8] Seventy to eighty per cent are female,[7,8] reflecting the predominance of females in the older age groups and the association of these fractures with osteoporosis.[9] A feature of this population is the high prevalence of preoperative medical problems. The poor medical condition of these patients is evident in the reported distribution of preoperative ASA physical status scores: approximately 50 per cent of patients are designated ASA class III, while another ten per cent are classified as ASA IV.[10] Cardiovascular disease is common: approximately one-half of patients have a history of ischaemic heart disease and about 20 per cent have hypertension.[11] Preoperative continuous ECG monitoring in a group of hip fracture patients has documented significant arrythmias in 40 per cent[12] and these arrythmias may be a factor in the occurrence of falls and subsequent fracture. Neurological dysfunction related to senile dementia, cerebrovascular disease and Parkinsonism, is present in approximately 30 per cent.[13] Chronic drug therapy is common and reflects the prevalence of underlying organ system disease.[14] The use of psychotropic drugs such as long half-life hypnotics-anxiolytics, tricyclic antidepressants, and antipsychotics has been associated with an increased risk of hip fracture.[15]

Preoperative hypoxaemia frequently occurs in hip fracture patients. Twenty-three per cent (13 of 57) of a patient group reported by Berggren *et al.*[11] demonstrated preoperative arterial hypoxaemia with PaO_2's less than 60 mmHg. Other investigators[16] have documented a wide

range of preoperative arterial oxygen tensions, with mean levels greater than 60 mmHg but significantly lower than age-predicted values. Proposed aetiologies include fat embolism related to the fracture and prolonged immobilization in the supine position.[17]

Medical stabilization of hip fracture patients is often necessary before surgery. Fracture repair is usually performed on an urgent basis to limit the period of preoperative immobilization, with its attendant risks of deep venous thrombosis and pulmonary complications.[1] In the absence of surgical indications for emergency surgery, however, it appears that delay for medical stabilization does not adversely affect outcome. In a review of 155 patients, Davidson *et al.*[18] could not associate preoperative delay with decreased survival. Kenzora *et al.*,[19] in a retrospective analysis, observed an unexplained increased mortality in patients undergoing surgery within 24 hours of hospital admission. No relationship between the timing of surgery and mortality was evident with preoperative periods of greater than one day.

Surgical considerations

Hip fractures are of two main types, fractures of the femoral neck and intertrochanteric fractures. Femoral neck fractures threaten the blood supply to the proximal bone fragment. These fractures have traditionally been treated with reduction and internal fixation. Fracture fixation is accomplished with multiple screws or pins (e.g., Knowles) or a compression screw-side plate assembly (e.g., Richards, Zimmer). Late complications are common, primarily nonunion and avascular necrosis of the femoral head. To avoid a second surgical procedure necessitated by these late complications, a medullary prosthesis for replacement of the head and neck of the femur is an alternative treatment. Although hemiarthroplasty procedures allow more rapid postoperative mobilization, operative time and blood loss are greater than with internal fixation procedures.[20] Postoperative mortality may be slightly higher for patients treated by hemiarthroplasty than those undergoing internal fixation.[21]

Intertrochanteric fractures are associated with more severe trauma than femoral neck fractures. Operative procedures for reduction and internal fixation involve more extensive surgical exposure and greater blood loss. Various devices are used for internal fixation: fixed angle nail plates (e.g., Jewett, Thorton), compression screw-side plate assemblies (e.g., Richards, Zimmer), and flexible medullary nails. Internal fixation is often technically more difficult than femoral neck fractures and early complications related to instability of the fracture fragments are more common.

Nonoperative management of proximal femoral fractures remains a treatment option for a small proportion of patients, particularly nonambulatory, demented geriatric patients.[22,23] Those patients with unacceptable perioperative risk may also be selectively treated by nonsurgical methods.[24]

TABLE I The effects of anaesthetic technique for hip fracture surgery on perioperative morbidity

Morbidity factor	*Anaesthetic effects*
Intraoperative blood pressure stability	Decreased blood pressure with GA and SA: SA>GA.
Blood loss	No effect for fractured neck. Possible decrease with SA for intertrochanteric.
Postoperative oxygenation	Better with SA (vs GA).
Confusion	No difference (EA vs GA).
Deep vein thrombosis	Decreased with SA (vs GA).
Time to ambulation	No difference

GA = general anaesthesia; SA = spinal anaesthesia; EA = epidural anaesthesia.

Anaesthetic considerations

Both regional and general anaesthesia have been used for hip fracture surgery. Experience with regional anaesthesia has predominantly involved spinal anaesthesia,[25] although epidural anaesthesia has been used with success.[11] Various general anaesthetic techniques have been employed, none with clear advantage.[26] The choice between regional and general anaesthetic techniques has often been guided by the preferences of the anaesthetist and patient. However, choice should also be based on the perioperative advantages of each type of anaesthesia (Table I).

Regional anaesthesia for hip fracture surgery involves some special concerns. Deep venous thrombosis is common in these patients and many will receive pharmacological prophylaxis, most commonly warfarin, aspirin and low-dose subcutaneous heparin.[27] The institution of these drugs either prior to or immediately after surgery may influence decisions regarding anaesthetic technique. Preoperative anticoagulant therapy, especially when associated with a demonstrable coagulopathy on a coagulation screen, is a contraindication to regional anaesthesia due to the risk of bleeding within the vertebral canal and consequent neurological injury.[28] This risk, however, is poorly quantitated for those patients receiving aspirin and subcutaneous heparin. This lack of information has prompted recommendations that the potential benefits of regional anaesthesia should outweigh the potential but unproven risks in these patients.[28,29]

The performance of a regional block for hip fracture surgery is often technically difficult. Lack of patient cooperation due to pain or the presence of dementia[30]

makes optimal positioning difficult. Some investigators have used small incremental doses of fentanyl[31] or ketamine[32] to facilitate positioning, while others have performed blocks without supplemental analgesia.[34] Technical failure in performing spinal anaesthesia for hip fracture surgery occurs in approximately ten per cent of cases.[10,31]

Intraoperative blood pressure stability is a problem, regardless of anaesthetic technique. Systolic blood pressure decreases by approximately 30 per cent from pre-anaesthetic levels during general anaesthesia for hip fracture surgery.[11] Larger decrements of systolic blood pressure occur with spinal[17] and epidural[11] anaesthesia. In a large multicentre trial, Davis *et al.*[10] reported that hypotension, defined as a decrease of systolic blood pressure more than 20 per cent of preinduction values for greater than ten minutes, occurred in 38 per cent of patients with subarachnoid block and 24 per cent of patients under general anaesthesia.

The relationship between anaesthetic technique and blood loss during hip fracture surgery is variable. Average intraoperative blood loss for internal fixation of femoral neck fractures is reported to be 250–300 ml regardless of the type of anaesthesia used.[17,34] However, groups which include patients undergoing internal fixation of intertrochanteric fractures and hemiarthroplasty procedures are reported to have higher intraoperative blood losses which may be reduced with spinal anaesthesia.[31] Davis *et al.*[32] reported perioperative blood loss in 132 patients, 65 per cent of whom had repair of intertrochanteric fractures. Mean intraoperative losses of approximately 470 ml with general anaesthesia were significantly higher than with spinal anaesthesia. Postoperative blood loss, about 200 ml, was unrelated to anaesthetic technique.

The incidence of postoperative hypoxaemia, mental confusion and deep venous thrombosis may relate to anaesthetic technique. Patients emerging from general anaesthesia have significantly lower arterial oxygen tensions than those recovering from spinal anaesthesia.[17] The pattern of oxygenation later in the postoperative period, however, is controversial. Davis *et al.*[32] reported that despite better oxygenation early after spinal anaesthesia, both general and spinal anaesthesia patient groups showed PaO_2's significantly below preoperative values on the first postoperative day, with recovery by the seventh postoperative day. In contrast, Berggren *et al.*[11] found early postoperative decreases of arterial oxygenation in those patients receiving general anaesthesia while patients who had epidural anaesthesia had no significant changes in oxygenation.

Postoperative confusion is common in the elderly: in a group of patients after hip fracture surgery, 36 per cent (33/91) were confused on the first postoperative day.[35] The aetiology of this confusion is unknown. Anticholinergic medication[36] and psychological effects of inhalational anaesthetics[37] have been implicated. Studies in the hip fracture population have not documented a relationship between postoperative confusion and anaesthetic technique. Berggren *et al.*[11] tested 57 patients one and seven days after surgical repair of hip fracture. Forty-four per cent developed confusion in the first postoperative week, with no differences between epidural and general anaesthesia groups. Factors associated with the development of confusion in this study were a preoperative history of mental depression and anticholinergic medication use, as well as early postoperative hypoxaemia in those who received general anaesthesia. Postoperative confusional states are transient, as testing at seven days and three months after hip fracture surgery reveals no major impairment of mental function in either spinal or general anaesthetic patient groups.[38] However, patients with postoperative confusion have significantly longer hospital stays.[11]

Evidence of deep venous thrombosis (DVT) is present in 40–50 per cent of hip fracture patients[39] and the incidence of fatal pulmonary embolism in patients without prophylaxis has been estimated at 3.5 per cent.[40] Studies demonstrating a reduction of DVT in these patients after spinal anaesthesia in comparison with general anaesthesia[32,41] have been criticized due to their use of fibrinogen uptake testing which is known to be inaccurate after hip surgery.[25] McKenzie *et al.*[33] used contrast venography to study 40 patients seven to ten days after surgery. They reported a 40 per cent incidence of DVT after spinal anaesthesia compared with 76.2 per cent after general anaesthesia. Significant differences persisted between the two groups when the data was analyzed to include only iliofemoral thromboses which carry a high risk of pulmonary embolism. Despite evidence that the incidence of DVT may be reduced by spinal anaesthesia, there is no data concerning the effect of anaesthetic technique on rates of pulmonary embolism in hip fracture patients. Changes in lower limb blood flow and blood viscosity have been suggested as important factors in the decrease of DVT after spinal anaesthesia.[25]

The effect of anaesthetic technique on postoperative mobilization is unclear. Bigler *et al.*[38] reported that patients mobilized sooner after spinal anaesthesia than general anaesthesia: 3.3 days versus 5.1 days respectively. However, in a recent multicentre trial comparing general and spinal anaesthesia for hip fracture repair, Valentin *et al.*[31] noted a median time of three days to ambulation unrelated to anaesthetic technique, with a wide variation (0–66 days) among patients.

Fractured hip has a reported hospital mortality rate of approximately eight per cent.[7] Longer-term studies indi-

cate that patients have decreased survival for the first eight months after hip fracture.[42] Mortality at one year approximates 20 per cent.[10] Factors influencing short-term mortality include age,[7] preoperative health status,[10,26] sex,[7,31] and possibly trochanteric fractures as opposed to fractures of the femoral neck.[10] Commonest causes of death in the first postoperative month are congestive heart failure, myocardial infarction, pneumonia and pulmonary embolism.[10,32,34]

The effect of anaesthetic technique on mortality after hip fracture surgery has been the subject of several prospective studies (Table II). Only two of these studies have documented a difference in outcome between spinal and general anaesthesia groups. McKenzie *et al.*[34] demonstrated a significantly lower two-week mortality after spinal versus general anaesthesia, although this early difference disappeared at two months with an 18 per cent cumulative mortality rate in each group. McLaren *et al.*,[43] following 55 patients, reported a difference in one month mortality: 31 per cent following general anaesthesia and 3.6 per cent after spinal anaesthesia. The latter findings have been disputed because of the inordinately high mortality in the general anaesthesia group and the small sample size.[31] Other studies have been unable to substantiate outcome differences. These include two recent reports[10,31] comparing spinal and general anaesthesia, each studying over 500 patients. Both studies documented one month mortality rates of approximately six per cent and this was not affected by anaesthetic technique.

Total hip arthroplasty

Total hip arthroplasty (THA) has been a major advance in the treatment of chronic arthritis of the hip,[45] and has proved effective in providing patients with pain relief and increased mobility.[46]

Patient population

The age of patients presenting for THA varies widely although approximately 60 per cent of procedures are performed on patients more than 65 years of age.[2] The aetiology of the underlying hip arthritis is variable.[47] Nearly one-half of patients presenting for THA have degenerative joint disease and approximately seven per cent have rheumatoid arthritis.[48] The latter group characteristically has multiple joint involvement which often includes the atlanto-axial and temporomandibular joints.[49] Retrospective data from THA patients estimates a ten per cent incidence of difficult intubation, primarily in those patients with rheumatoid arthritis and ankylosing spondylitis.[50]

Severe preexisting medical disease in THA patients is uncommon, with approximately 80 per cent being categorized as ASA physical status I or II.[50] Chronic drug therapy is frequent: more than half of patients take non-steroidal antiinflammatory agents.[51] Preoperative medical optimization is facilitated by the elective nature of THA.

Surgical considerations

THA involves prosthetic replacement of both femoral and acetabular components of the hip joint.[47] There is significant operative trauma to both soft tissue and bone marrow with resultant haemorrhage.[52] The surgical procedure includes amputation of the femoral head with or without the greater trochanter, and extensive reaming of both the acetabulum and the femoral shaft.[47] Acrylic cement (polymethylmethacrylate) is used for fixation of components, although many newer prostheses are cementless and depend on bone ingrowth for biological fixation. Mean operative time is 100–150 minutes.[53,54] The primary indication for THA is disabling pain and functional limitation of the hip despite adequate medical therapy.[2] Failed orthopaedic procedures are an increasing

TABLE II Randomized, prospective studies of the effect of anaesthetic technique on mortality after hip fracture surgery

Study	*Techniques compared*	*Observation time*	*Significant mortality difference*
McLaren *et al.*[43]	SA, GA	1 month	yes (GA > SA)
McKenzie *et al.*[17]	SA, GA	1 month	no
White *et al.*[44]	SA, GA, psoas block	1 month	no
Davis *et al.*[32]	SA, GA	1 month	no
Wickstrom *et al.*[26]	EA, GA	1 month	no
McKenzie *et al.*[34]	SA, GA	2 weeks	yes (GA > SA)
		2 months	no
Valentin *et al.*[31]	SA, GA	1 month	no
Davis *et al.*[10]	SA, GA	1 month	no

SA = spinal anaesthesia; GA = general anaesthesia; EA = epidural anaesthesia.

indication for THA.[46] Approximately ten per cent of THA's will require revision surgery in the first ten years.[55]

Anaesthetic considerations

Spinal,[56,57] epidural[58] and various techniques of general anaesthesia[59] have been used successfully for THA. The major intraoperative anaesthetic concerns during THA are blood loss, hypoxaemia and cardiovascular instability. Blood loss is related to intraoperative tissue trauma, especially the reaming of medullary bone,[52] and increases if an osteotomy of the greater trochanter is performed to improve surgical exposure or with revision procedures.[56] Reported blood loss is variable,[60] averaging 0.5 L to 1.5 L intraoperatively[52] and 300–500 ml in the postoperative period.[53,60,61]

Anaesthetic technique is an important factor affecting blood loss during THA. Intraoperative losses are significantly reduced with both spinal[56,62] and epidural[53,60] techniques when compared with general anaesthesia and this reduction does not appear related to differences in systemic blood pressure. A comparison of patients undergoing general anaesthesia with those undergoing combined epidural and general anaesthesia has revealed significantly lower blood losses in the patients with regional blockade, despite similar mean intraoperative blood pressures.[51] Blood loss during subarachnoid blockade also appears unrelated to systemic blood pressure as maintenance of higher arterial pressures with ephedrine during spinal anaesthesia does not affect blood loss.[63] The effect of regional techniques on intraoperative bleeding may be due to the emptying of dilated nondependent vessels by gravity, especially in the lateral position,[59] and the absence of controlled ventilation which may increase venous pressure and bleeding.[51] Postoperative blood loss has also been reported to decrease with the maintenance of a local anaesthetic epidural blockade during the first 24 hours after surgery.[58]

During general anaesthesia for THA blood loss correlates with systolic blood pressure.[64] Controlled hypotension during general anaesthesia reduces intraoperative blood loss during THA compared with normotensive general anaesthesia and epidural techniques.[59] Both inhalational agents (halothane,[65] isoflurane,[66]) and sodium nitroprusside[54] have been used successfully to reduce blood loss. In a recent study[66] comparing isoflurane with sodium nitroprusside, both agents were efficacious in producing moderate hypotension with associated intraoperative blood losses of 300–400 ml. However, the risks of hypotensive anaesthesia in elderly patients presenting for THA, namely hypoperfusion with resulting organ damage, are poorly quantitated. In a study using either halothane or sodium nitroprusside to produce mean arterial pressures of 50 mmHg during THA, Thompson *et al.*[67] could not demonstrate changes in postoperative tests of cerebral, hepatic or renal function. These patients, however, were without major organ system disease and the mean age of the experimental groups was 57–61 years. Potential risks of induced hypotension must be balanced against the benefits of minimizing blood transfusion.[68]

Intraoperative cardiovascular instability has been a problem during THA, with reports of both hypotension[69] and cardiac arrest.[70] Hypotension is transient and occurs commonly following impaction of the femoral prosthesis into the bone marrow cavity filled with acrylic cement.[71] Several explanatory hypotheses have been proposed including the absorption of acrylic cement monomers into the circulation,[72] as well as pulmonary embolism of fat,[73], air,[74,75], and platelet-fibrin aggregates.[71] Theories of pulmonary embolism have been supported by the documentation of significant but transient falls of arterial oxygen tensions which commonly occur after impaction of the femoral prosthesis.[52,71,76] This is associated with an increase in mean pulmonary artery pressure, pulmonary vascular resistance and total pulmonary venous admixture.[76] Modig *et al.*[71] demonstrated the presence of tissue thromboplastic activity, fat globules, bone marrow cells and acrylic monomers in pulmonary arterial blood during THA. Hypotension and decreases in arterial oxygenation correlated significantly with the release of tissue thromboplastic products in the pulmonary circulation. These changes were most marked after impaction of the femoral prosthesis but also occurred after insertion of the acetabular component. The phenomenon of pulmonary embolism may relate to high intramedullary pressures during impaction of the femoral component.[77] An appropriately placed vent to allow the escape of marrow contents can prevent the pressure increase.[78] Careful maintenance of normovolaemia and supplemental inspired oxygen have been recommended to attenuate decreases of blood pressure and arterial oxygenation at the time of prosthesis placement.[79]

Morbidity following THA may relate to anaesthetic technique.[25] Deep vein thrombosis (DVT) is common after THA, affecting an estimated 60 per cent of patients,[80] and approximately 20 per cent of patients have evidence of pulmonary embolism by lung scan.[54] Epidural anaesthesia, maintained 24 hours postoperatively for analgesia, has been shown to decrease the incidence of DVT after THA when compared with general anaesthesia.[53,58,81] In addition, Modig *et al.*[58] have demonstrated significantly fewer segmental defects on postoperative lung scans in THA patients after extended local anaesthetic epidural blocks. A reduced incidence of DVT has also

been demonstrated after spinal anaesthesia for THA.[62] Hypotheses to explain this effect of regional anaesthesia on thromboembolism include local changes in the distribution and magnitude of blood flow[81] and alterations in the coagulation and fibrinolysis cascades[82] perhaps related to an altered neuroendocrine response to surgery.[83]

The relationship of mental function after THA and anaesthetic technique is uncertain. In a study of patients given either general or epidural anaesthesia for THA and evaluated by interviews in the first 12 postoperative days, significantly more patients demonstrated mental changes after general anaesthesia.[84] However, Riis *et al.*[85] performed psychological testing on patients during the first week after THA under general anaesthesia, epidural anaesthesia, and combined epidural and general anaesthesia. Impairment of mental performance during the first three to four postoperative days was equally distributed among the groups.

Regional techniques may be useful in providing analgesia after THA. Spinal anaesthesia using bupivacaine with added morphine has been shown to provide good operating conditions as well as excellent pain relief for major hip surgery, although monitoring for respiratory depression is necessary in the first 24 hours following surgery.[86] Postoperative regional blockade may have additional salutory effects on oxygenation. Studies comparing regimens of systemic narcotic analgesics and epidural local anaesthetics after THA have demonstrated that patients with epidural analgesia do not show significant decreases in arterial oxygenation characteristic of the patients treated with narcotics.[87,88]

Operative mortality related to THA is less than one per cent.[20] Pulmonary embolism is the most common cause of death, although incidence rates of both fatal and nonfatal pulmonary embolism have been reduced by prophylaxis with dextran, warfarin, subcutaneous heparin, or dihydroergotamine.[89] Data relating mortality after THA to anaesthetic technique do not exist.[25] Although regional techniques appear to decrease the incidence of DVT and pulmonary embolism, studies with patient groups large enough to demonstrate mortality differences are not available.

Conclusion

The choice of optimum anaesthetic technique for hip surgery involves weighing of the available data, as well as personal preferences of both the patient and the anaesthetist. In the hip fracture population, investigations have not demonstrated that the type of anaesthesia, either regional or general, significantly alters morbidity or mortality. This allows personal preference to be the predominant factor guiding anaesthetic choice in most cases. For those patients undergoing THA, however, there is stronger data supporting a salutory effect of regional anaesthesia on morbidity. Blood loss can be significantly reduced with regional techniques, although this can also be accomplished with controlled hypotension during general anaesthesia. In addition, regional anaesthesia reduces the incidence of both DVT and pulmonary embolism in these patients. These data suggest that regional anaesthesia, either alone or combined with general anaesthesia, is the technique of choice. A definitive recommendation, however, must await documentation of improved outcome after regional anaesthesia for THA.

References

1 *Sisk TD.* Fractures of the hip and pelvis. *In*: Campbell's Operative Orthopaedics, vol 3. Crenshaw AH (Ed.). St. Louis: The C.V. Mosby Company, 1987: 1719–81.

2 Total hip-joint replacement in the United States. Consensus development conference of the National Institute of Health. JAMA 1982; 248: 1817–21.

3 United States Congress Office of Technology Assessment. The context of the report. *In*: Life sustaining technologies and the elderly. Washington, DC: United States Government Printing Office, 1987: 39–88.

4 *Kelsey JL, Hoffman S.* Risk factors for hip fracture. N Engl J Med 1987; 316: 404–6.

5 *Gallannaugh SC, Martin A, Millard PH.* Regional survey of femoral neck fractures. Br Med J 1976; 2: 1496–7.

6 Editorial. The old woman with a broken hip. Lancet 1982; 2: 419–20.

7 *Jensen JS, Tondevold E.* Mortality after hip fractures. Acta Orthop Scand 1979; 50: 161–7.

8 *Cummings SR, Kelsey JL, Nevitt MC, O'Dowd KJ.* Epidemiology of osteoporosis and osteoporotic fractures. Epidemiol Rev 1985; 7: 178–208.

9 *Melton LJ III, Wahner HW, Richelson LS, O'Fallon WM, Riggs BL.* Osteoporosis and the risk of hip fracture. Am J Epidemiol 1986; 124: 254–61.

10 *Davis FM, Woolner DF, Frampton C 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.

11 *Berggren D, Gustafson Y, Eriksson B et al.* Postoperative confusion after anaesthesia in elderly patients with femoral neck fractures. Anesth Analg 1987; 66: 497–504.

12 *Abdon NJ, Nilsson BE.* Episodic cardiac arrythmia and femoral neck fracture. Acta Med Scand 1980; 208: 73–6.

13 *Ceder L, Elmgvist D, Svensson S.* Cardiovascular and neurological function in elderly patients sustaining a fracture of the neck of the femur. J Bone Joint Surg 1981; 63B: 560–6.

14 *Rashiq S, Logan RF.* Role of drugs in fractures of the femoral neck. Br Med J 1986; 292: 861–3.

15 *Ray WA, Griffin MR, Schaffner W, Baugh DK, Melton JL III.* Psychotropic drug use and the risk of hip fracture. N Engl J Med 1987; 316: 363–9.
16 *Martin VC.* Hypoxaemia in elderly patients suffering from fractured neck of femur. Anaesthesia 1977; 32: 852–67.
17 *McKenzie PJ, Wishart HY, Dewar KMS, Gray I, Smith G.* Comparison of the effects of spinal anaesthesia and general anaesthesia on postoperative oxygenation and perioperative mortality. Br J Anaesth 1980; 52: 49–53.
18 *Davidson TI, Bodey WN.* Factors influencing survival following fractures of the upper end of the femur. Injury 1986; 17: 12–4.
19 *Kenzora JE, McCarthy RE, Lowell JD, Sledge MD.* Hip fracture mortality. Clin Orthop 1987; 223: 188–93.
20 *Soreide O, Molster A, Raugstad TS.* Internal fixation versus primary prosthetic replacement in acute femoral neck fractures: a prospective, randomized clinical study. Br J Surg 1979; 66: 56–60.
21 *DeLee JC.* Fractures and dislocations of the hip. *In*: Fractures in Adults, vol 2. Rockwood CA Jr, Green DP (Eds.). Philadelphia: J.B. Lippincott Company, 1984; 1211–1356.
22 *Winter WG.* Nonoperative treatment of proximal femoral fractures in the demented, nonambulatory patient. Clin Orthop 1987; 218: 97–103.
23 *Lyon LJ, Nevins MA.* Management of hip fractures in nursing home patients: to treat or not to treat? J Am Geriatr Soc 1984; 32: 391–5.
24 *Gotfried Y, Frish E, Mendes DG, Roffman M.* Intertrochanteric fractures in high risk geriatric patients treated by external fixation. Orthopedics 1985; 8: 769–74.
25 *McKenzie PJ, Loach AB.* Local anaesthesia for orthopaedic surgery. Br J Anaesth 1986; 58: 779–89.
26 *Wickstrom I, Holmberg I, Stefansson T.* Survival of female geriatric patients after hip fracture surgery. A comparision of 5 anesthetic methods. Acta Anaesthesiol Scand 1982; 26: 607–14.
27 *Paiement GD, Essinger SJ, Harris WH.* Survey of prophylaxis against venous thromboembolism in adults undergoing hip surgery. Clin Orthop 1987; 223: 188–93.
28 *Murphy TM.* Spinal, epidural, and caudal anaesthesia. *In*: Anesthesia, vol 2. Miller RD (Ed.). New York: Churchill Livingstone, 1986; 1061–1111.
29 *Owens EL, Kasten GW, Hessel EA II.* Spinal subarachnoid hematoma after lumbar puncture and heparinization. Anesth Analg 1986; 65: 1201–7.
30 *Haljamae H, Stefansson T, Wickstrom I.* Preanesthetic evaluation of the female geriatric patient with hip fracture. Acta Anaesthesiol Scand 1982; 26: 393–402.
31 *Valentin N, Lomholt B, Jensen JS, Hejgaard N, Kreiner S.* Spinal or general anaesthesia for surgery of the fractured hip? Br J Anaesth 1986; 58: 284–91.
32 *Davis FM, Laurenson VG.* Spinal anaesthesia or general anaesthesia for emergency hip surgery in elderly patients. Anaesth Intensive Care 1981; 9: 352–8.
33 *McKenzie PJ, Wishart HY, Gray I, Smith G.* Effects of anaesthetic technique on deep vein thrombosis. Br J Anaesth 1985; 57: 853–7.
34 *McKenzie PJ, Wishart HY, Smith G.* Long term outcome after repair of fractured neck of femur. Br J Anaesth 1984; 56: 581–4.
35 *Williams MA, Holloway JR, Winn MC et al.* Nursing activities and acute confusional states in elderly hip-fractured patients. Nurs Res 1979; 28: 25–35.
36 *Tune LE, Holland A, Folstein MF et al.* Association of postoperative delirium with raised serum levels of anticholinergic drugs. Lancet 1981; 2: 651–3.
37 *Davison LA, Steinhelber JC, Eger EI II, Stevens WC.* Psychological effects of halothane and isoflurane anaesthesia. Anesthesiology 1975; 43: 313–24.
38 *Bigler D, Adelhoj B, Petring OU, Pederson NO, Busch P, Kalhke P.* Mental function and morbidity after acute hip surgery during spinal and general anaesthesia. Anaesthesia 1985; 40: 672–6.
39 *Salzman EW, Harris WH.* Prevention of venous thromboembolism in orthopaedic patients. J Bone Joint Surg 1976; 58A: 903–13.
40 *Sharnoff JG, Rosen RL, Sadler AH, Ibarra-Isunza GC.* Prevention of fatal pulmonary thromboembolism by heparin prophylaxis after surgery for hip fractures. J Bone Joint Surg 1976; 58A: 913–8.
41 *Davis FM, Quince M, Laurenson VG.* Deep vein thrombosis and anaesthetic technique in emergency hip surgery. Br Med J 1980; 281: 1528–9.
42 *Miller CW.* Survival and ambulation following hip fracture. J Bone Joint Surg 1978; 60A: 930-4.
43 *McLaren AD, Stockwell MC, Reid VT.* Anaesthetic techniques for surgical correction of fractured neck of femur. Anaesthesia 1978; 33: 10–4.
44 *White IW, Chappell WA.* Anaesthesia for surgical correction of fractured femoral neck. Anaesthesia 1980; 35: 1107–10.
45 *Liang MH, Cullen KE, Larson MG et al.* Cost-effectiveness of total joint arthroplasty in osteoarthritis. Arthritis Rheum 1986; 29: 937–43.
46 *Liang MH, Cullen KE, Poss R.* Primary total hip or knee replacement: evaluation of patients. Ann Intern Med 1982; 97: 735–9.
47 *Calandruccio RA.* Arthroplasty of hip. *In*: Campbell's Operative Orthopedics, vol 2. Crenshaw AH (Ed.). St. Louis: The C.V. Mosby Company, 1987; 1213–1501.
48 *Melton JL III, Stauffer RN, Chao EY, Ilstrup DM.* Rates of total hip arthroplasty. N Engl J Med 1982; 307: 1242–5.
49 *Gibb PS, Kim KC.* Skin and musculoskeletal diseases. *In*: Anaesthesia and Co-existing Disease. Stoelting RK,

Dierdorf SF (Eds.). New York: Churchill Livingstone, 1983; 573–603.

50 *Koide M, Pilone RN, Vandam LD, Lowell JD.* Anaesthetic experience with total hip replacement. Clin Orthop 1974; 99: 78–85.

51 *Chin SP, Abou-Madi MN, Eurin B, Witvoet J, Montagne J.* Blood loss in total hip replacement: extradural v. phenoperidine analgesia. Br J Anaesth 1982; 54: 491–4.

52 *Modig J, Busch C, Olerud S, Saldeen T.* Pulmonary microembolism during intramedullary orthopedic trauma. Acta Anaesthesiol Scand 1974; 18: 133–43.

53 *Modig J, Borg T, Karlstrom G, Maripuu E, Sahlstedt B.* Thromboembolism after total hip replacement: role of epidural and general anesthesia. Anesth Analg 1983; 62: 174–80.

54 *Fredin H, Gustafson C, Rosberg B.* Hypotensive anesthesia, thromboprophylaxis and postoperative thromboembolism in total hip arthroplasty. Acta Anaesthesiol Scand 1984; 28: 503–7.

55 Total hip-joint replacement in Sweden. Consensus development conference of the National Institute of Health. JAMA 1982; 248: 1822–4.

56 *Sculco TP, Ranawat C.* The use of spinal anesthesia for total hip-replacement arthroplasty. J Bone Joint Surg 1975; 57-A: 173–7.

57 *Davis FM, Laurenson VG, Lewis J, Wells JE, Gillespie WJ.* Metabolic response to total hip arthoplasty under hypobaric subarachnoid or general anesthesia. Br J Anaesth 1987; 59: 725–9.

58 *Modig J, Maripuu E, Sahlstedt B.* Thromboembolism following total hip replacement. Reg Anaesth 1986; 11: 72–9.

59 *Rosberg B, Fredin H, Gustafson C.* Anesthetic techniques and surgical blood loss in total hip arthroplasty. Acta Anaesthesiol Scand 1982; 26: 189–93.

60 *Keith I.* Anesthesia and blood loss in total hip replacement. Anaesthesia 1977; 32: 444–50.

61 *Barbier-Bohm G, Desmonts JM, Coudero E, Moulin D, Prokocimer P, Oliver H.* Comparative effects of induced hypotension and normovolemic haemodilution on blood loss in total hip arthroplasty. Br J Anaesth 1980; 52: 1039–43.

62 *Thorburn J, Louden JR, Vallance R.* Spinal and general anaesthesia in total hip replacement: frequency of deep vein thrombosis. Br J Anaesth 1980; 52: 1117–20.

63 *Thorburn J.* Subarachnoid blockade and total hip replacement. Br J Anaesth 1985; 57: 290–3.

64 *Amaranath L, Cascorbi HF, Singh-Amaranath AV, Frankmann DB.* Relation of anaesthesia to total hip replacement and control of operative blood loss. Anesth Analg 1975; 54: 641–8.

65 *Qvist TF, Skovsted P, Srensen MB.* Moderate hypotensive anaesthesia for reduction of blood loss during total hip replacement. Acta Anaesthesiol Scand 1982; 26: 351–3.

66 *Bernard JM, Pinaud M, Ganansia MF, Chatelier H, Souron R, Letenneur J.* Systemic haemodynamic and metabolic effects of deliberate hypotension with isoflurane anaesthesia or sodium nitroprusside during total hip arthroplasty. Can J Anaesth 1987; 34: 135–40.

67 *Thompson GE, Miller RD, Stevens WC.* Hypotensive anesthesia for total hip arthoplasty: a study of blood loss and organ function (brain, heart, liver and kidney). Anesthesiology 1978; 48: 91–6.

68 *Lam AM.* Induced hypotension. Can Anaesth Soc J 1984; 31: S56–62.

69 *Newens AF, Volz RG.* Severe hypotension during prosthetic hip surgery with acrylic bone cement. Anesthesiology 1972; 36: 298–300.

70 *Cohen CA, Smith TC.* The intraoperative hazard of acrylic bone cement: report of a case. Anesthesiology 1971; 35: 547–9.

71 *Modig J, Busch C, Olerud S, Saldeen T, Waernbaum G.* Arterial hypotension and hypoxemia during total hip replacement: the importance of thromboplastic products, fat embolism and acrylic monomers. Acta Anaesthesiol Scand 1975; 19: 28–43.

72 *Peebles DJ, Ellis RH, Stride SD, Simpson BR.* Cardiovascular effects of methylmethacrylate cement. Br Med J 1972; 1: 349–51.

73 *Alexander JP.* Clinical considerations in anaesthesia for hip arthroplasty. Anaesthesia 1978; 33: 748–51.

74 *Michel R.* Air embolism in hip surgery. Anaesthesia 1980; 35: 858–62.

75 *Andersen KH.* Air aspirated from the venous system during total hip replacement. Anaesthesia 1983; 38: 1175–8.

76 *Modig J, Malmberg P.* Pulmonary and circulatory reactions during total hip replacement surgery. Acta Anaesthesiol Scand 1975; 19: 219–37.

77 *Tronzo RG, Kallos T, Wyche MQ.* Elevation of intramedullary pressure when methylmethacrylate is inserted in total hip arthoplasty. J Bone Joint Surg 1974; 54: 714–8.

78 *Jones RH.* Physiologic emboli changes observed during total hip replacement arthoplasty. Clin Orthop 1975; 112: 192–200.

79 *Kallos T.* Impaired arterial oxygenation associated with the use of bone cement in the femoral shaft. Anesthesiology 1975; 42: 210–6.

80 *Moskovitz PA, Ellenberg SS, Feffer HL et al.* Low-dose heparin for prevention of venous thromboembolism in total hip arthroplasty and surgical repair of hip fractures. J Bone Joint Surg 1978; 60-A: 1065–70.

81 *Modig J, Malmberg P, Karlstrom G.* Effect of epidural

versus general anaesthesia on calf blood flow. Acta Anaesthesiol Scand 1980; 24: 305–9.

82 *Modig J, Borg T, Bagge L, Saldeen T.* Role of extradural and of general anaesthesia in fibrinolysis and coagulation after total hip replacement. Br J Anaesth 1983; 55: 625–9.

83 *Davis FM, Laurenson VG, Lewis J, Wells JE, Gillespie WJ.* Metabolic response to total hip arthroplasty under hypobaric subarachnoid or general anaesthesia. Br J Anaesth 1987; 59: 725–9.

84 *Hole A, Terjesen T, Breivik H.* Epidural versus general anaesthesia for total hip arthroplasty in elderly patients. Acta Anaesthesiol Scand 198; 24: 279–87.

85 *Riis J, Lomholt B, Haxholdt O et al.* Immediate and long-term mental recovery from general versus epidural anesthesia in elderly patients. Acta Anaesthesiol Scand 1983; 27: 44–9.

86 *Johnson A, Bengtsson M, Merits H, Lofstrom JB.* Anesthesia for major hip surgery. Reg Anaesth 1986; 11: 83–8.

87 *Modig J.* Respiration and circulation after total hip replacement surgery. Acta Anaesthesiol Scand 1976; 20: 225–36.

88 *Catley DM, Thornton C, Jordan C, Lehane JR, Royston D, Jones JG.* Pronounced, episodic desaturation in the postoperative period: its association with ventilatory pattern and analgesic regimen. Anesthesiology 1985; 63: 20–8.

89 *Johnson R, Green JR, Charnley J.* Pulmonary embolism and its prophylaxis following the Charnley total hip replacement. Clin Orthop 1977; 127: 123–32.

Résumé

Les candidats à une arthroplastie ou encore à une réduction de fracture de la hanche sont habituellement agés. Les victimes de fracture de la hanche ont aussi souvent de nombreux problèmes médicaux dont on doit s'occuper avant l'intervention. Entre autres, l'institution d'une prophylaxie anti-thrombotique peut contre-indiquer l'anesthésie régionale qui par ailleurs semble associée à des épisodes hypotensifs plus fréquents et sérieux que ne l'est l'anesthésie générale. Cependant, avec l'anesthésie rachidienne, l'incidence de thrombose veineuse profonde est réduite et l'oxygénation des patients est meilleure en post-op immédiat. Toutefois, ni les pertes sanguines (250–300 ml), ni la confusion post-opératoire non plus que la mortalité à un mois (huit pour cent) ne sont influencées par le type d'anesthésie. Les arthroplasties de la hanche se prêtent à divers types d'anesthésie: rachidienne, péridurale et générale. Les pertes sanguines (0.5–1.5 litres) sont cependant moindres avec les techniques régionales ou quand on adjoint de l'hypotension controlée à l'anesthésie générale. En période per-opératoire, l'insertion de la prothèse fémorale peut causer de l'hypoxémie, de l'hypotension et même un arrêt cardiaque dont les mécanismes vont de l'absorption de monomères d'acrylique à l'embolisation des artères pulmonaires par de l'air, des particules graisseuses ou des agrégats plaquettaires. On sait par ailleurs que l'anesthésie péridurale réduit le risque de thrombose veineuse profonde, complication fréquente, et que l'embolie pulmonaire est responsable de la majorité des décès survenant en période péri-opératoire (moins de un pour cent des cas). Cependant aucune relation entre le type d'anesthésie et la mortalité n'a été établie. La morbidité et la mortalité associées au traitement chirurgical des fractures de la hanche ne semblent pas influencées de façon significative par le type d'anesthésie. Pour les arthroplasties totales de la hanche, l'anesthésie régionale comporte moins de risques de thrombose veineuse et d'embolie pulmonaire, elle minimise les pertes sanguines et s'avère peut-être la technique de choix, seule ou combinée à l'anesthésie générale.