

Regional versus General Anesthesia in Elderly Patients Undergoing Hip Fracture Surgery: A Narrative Review of Outcomes and Evidence

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Abstract:

Hip fracture is one of the most common and consequential injuries of old age, and the choice of anesthetic technique for its surgical repair remains a subject of active clinical and research interest. This narrative review synthesises evidence from randomized controlled trials, large national registries, and systematic reviews/meta-analyses comparing regional (chiefly spinal) anesthesia with general anesthesia in elderly patients undergoing hip fracture surgery. Drawing principally on the pragmatic REGAIN trial (n = 1,600), a 107,028-patient cohort from the National Hip Fracture Database of England, Wales and Northern Ireland, and pooled data from more than twenty comparative studies, the review examines outcomes including 30-day and in-hospital mortality, postoperative delirium, length of hospital stay, early mobilisation, return to original residence, pain, blood loss and cost. The overall pattern is one of clinical equipoise for hard outcomes such as 60-day mortality and the ability to walk independently, alongside modest but consistent secondary benefits with regional anesthesia — shorter hospital stay, lower odds of delirium, better early mobilisation and higher rates of discharge to original residence — set against greater early postoperative pain and demands on patient cooperation and anatomical suitability. The review concludes that neither technique is categorically superior, and that individualised, shared decision-making informed by patient factors, anticoagulation status, cognitive status and institutional expertise should guide anesthetic choice, supported by joint orthogeriatric and anesthetic care pathways.

Index Terms - hip fracture; regional anesthesia; spinal anesthesia; general anesthesia; elderly; geriatric surgery; postoperative delirium; mortality; narrative review.

I. INTRODUCTION

Hip fracture is a sentinel event in the life of an older adult. It marks not only an acute orthopaedic injury but frequently the beginning of a cascade of functional decline, loss of independence, and heightened mortality risk that can persist for a year or more after the index event. Worldwide, hip fractures occur predominantly in people over the age of 65, most commonly as a consequence of a low-energy fall in the

context of osteoporosis, sarcopenia and multimorbidity. Because almost all displaced or unstable hip fractures require surgical fixation or arthroplasty to restore mobility and relieve pain, virtually every patient with a hip fracture who is fit for surgery will require an anesthetic, making the anesthetic technique itself a modifiable variable of considerable clinical importance.

Two broad anesthetic strategies dominate contemporary practice: general anesthesia (GA), in which consciousness is pharmacologically abolished and the airway is instrumented or supported, and regional anesthesia (RA), most often a single-shot spinal (subarachnoid) block, sometimes combined with light procedural sedation. Both techniques are used extensively, and national registries show that practice varies considerably between institutions and countries, reflecting the absence, until relatively recently, of a large, definitive randomized trial and the persistence of conflicting signals from smaller trials and observational cohorts.

The clinical stakes of this choice are high. Elderly patients presenting for hip fracture surgery are frequently frail, cognitively vulnerable, and burdened by cardiovascular, respiratory and renal comorbidity; many are anticoagulated or antiplatelet-treated for atrial fibrillation, venous thromboembolism or coronary disease. General anesthesia carries risks related to airway management, aspiration, haemodynamic instability during induction, and postoperative respiratory depression, while regional anesthesia carries its own risks related to hypotension, the technical difficulty of neuraxial puncture in patients with spinal deformity or anticoagulation, and the demands it places on patient cooperation. Advocates of regional anesthesia have long argued that avoidance of airway instrumentation and volatile agents should reduce delirium, respiratory complications and mortality; sceptics point out that well-conducted trials have repeatedly failed to demonstrate large differences in hard outcomes.

This narrative review synthesises the current body of evidence — randomized controlled trials, large-scale registry/cohort studies, and systematic reviews with meta-analysis — comparing regional and general anesthesia for hip fracture surgery in older adults. It aims to (i) summarise the epidemiological burden that makes this question important, (ii) describe the two anesthetic approaches and how they are used in contemporary practice, (iii) present the key comparative evidence on mortality, delirium, functional recovery, pain, haemodynamic and haematological outcomes, and cost, and (iv) distil practical, clinically actionable conclusions for anesthetic decision-making in this population.

II. METHODS OF LITERATURE REVIEW

This is a narrative rather than a systematic review, intended to synthesise and contextualise the highest-quality available evidence rather than to exhaustively catalogue every published study. A structured search of PubMed/MEDLINE, the Cochrane Library and major anesthesia and orthopaedic journals was conducted for English-language publications addressing regional versus general anesthesia for hip fracture surgery in adults, with priority given to the largest and most methodologically robust sources: multicentre randomized controlled trials, national or multinational registry-based cohort studies, and systematic reviews with meta-analysis published within the last decade. Search terms included combinations of “hip fracture”, “femoral neck fracture”, “spinal anesthesia”, “regional anesthesia”, “neuraxial anesthesia”, “general anesthesia”, “delirium”, “mortality” and “older adults”.

Three evidence sources anchor this review: the pragmatic, multicentre Regional versus General Anesthesia for Promoting Independence after Hip Fracture (REGAIN) randomized trial; a prospective cohort analysis of 107,028 patients drawn from the National Hip Fracture Database (NHFD) of England, Wales and Northern Ireland; and pooled data from systematic reviews and meta-analyses of both randomized and

observational studies, including a 23-study meta-analysis of general versus neuraxial anesthesia. Where numerical effect estimates (odds ratios, risk ratios, or mean differences with 95% confidence intervals) were reported in the source publications, they are reproduced here; where the underlying literature reports a qualitative or directional finding without a precise pooled estimate, this is stated explicitly rather than a number being invented. Given the narrative design, no formal risk-of-bias scoring or PRISMA flow diagram was undertaken; readers seeking a fully systematic synthesis are directed to the cited meta-analyses.

III. EPIDEMIOLOGICAL BURDEN OF HIP FRACTURE IN OLDER ADULTS

3.1 Global and Regional Incidence

Hip fracture incidence rises steeply with age and is markedly higher in women than men, reflecting the combined effects of osteoporosis, oestrogen deficiency and greater longevity. Classic modelling by Gullberg, Johnell and Kanis estimated approximately 1.26 million hip fractures worldwide in 1990 (about 338,000 in men and 917,000 in women), and projected that, under a conservative assumption of unchanging age- and sex-specific incidence rates, the annual global total would rise to approximately 4.5 million by 2050 purely as a consequence of population ageing; if secular trends in fracture rates were also factored in, projections ranged considerably higher. A particularly striking feature of these projections is the shifting geography of the burden: Asia accounted for roughly one quarter of all hip fractures in 1990, a share projected to rise to over a third by 2025 and to almost half of the global total by 2050, reflecting the scale and pace of population ageing in the region.

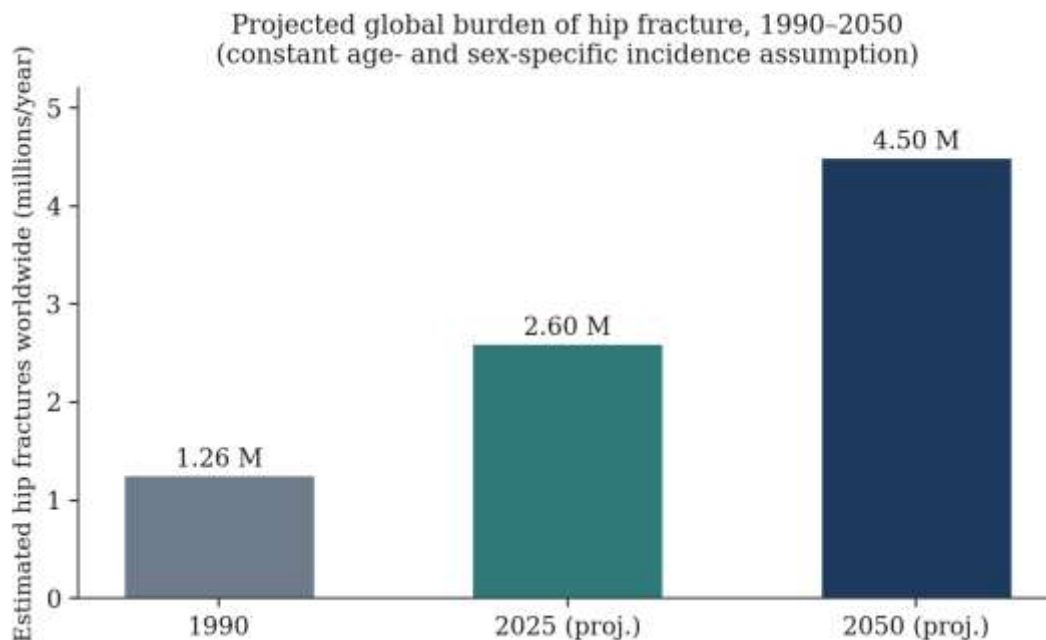


figure 1. projected global burden of hip fracture from 1990 to 2050 under a constant age- and sex-specific incidence assumption (data derived from gullberg et al., 1997).

3.2 Mortality and Disability After Hip Fracture

Beyond its acute morbidity, hip fracture is associated with substantial excess mortality that persists well beyond the perioperative period. Multiple cohort studies and systematic reviews report that between

roughly one in five and one in three patients who sustain a hip fracture die within the following year, a rate several-fold higher than age- and sex-matched peers without fracture, with the greatest relative excess risk concentrated in the first three to six months. Survivors frequently experience a permanent step-down in functional status: a substantial proportion never regain their pre-fracture level of mobility, and many who lived independently before the fracture require institutional or supported care afterwards. These downstream consequences underscore why perioperative care — including the choice of anesthetic technique — has attracted sustained research attention: even modest, reproducible improvements in early complications, mobilisation or delirium could translate into meaningful gains in independence for a very large and growing population of older adults.

IV. ANAESTHETIC TECHNIQUES FOR HIP FRACTURE SURGERY

4.1 General Anaesthesia

General anesthesia for hip fracture surgery typically involves intravenous induction, airway management with a supraglottic device or tracheal tube, and maintenance with a volatile agent or total intravenous anesthesia, supplemented with systemic opioids and often a peripheral nerve or fascia iliaca block for analgesia. Its advantages include reliability of surgical conditions, applicability regardless of spinal anatomy or coagulation status, and the ability to secure and control the airway in patients who cannot cooperate with a regional technique because of cognitive impairment, agitation or positioning difficulty. Its principal risks in this population relate to haemodynamic instability at induction and emergence, aspiration risk in patients who may not be reliably fasted after an acute injury, postoperative nausea, and a hypothesised — though inconsistently demonstrated — association with postoperative delirium and cognitive dysfunction.

4.2 Regional (Neuraxial) Anaesthesia

Regional anesthesia for hip fracture surgery is most commonly a single-shot spinal (subarachnoid) block using a local anesthetic such as hyperbaric bupivacaine, sometimes combined with an intrathecal opioid, and administered with or without procedural sedation. Epidural anesthesia and combined spinal-epidural techniques are used less frequently in this population. Proposed advantages include avoidance of airway instrumentation, reduced systemic opioid requirement, preserved airway reflexes, and — in theory — a lower burden of postoperative delirium and pulmonary complications. Technical challenges include difficult positioning in a patient with an acute, painful fracture, anatomical difficulty from spinal degenerative disease or deformity, contraindications from anticoagulant or antiplatelet therapy, and the risk of clinically significant hypotension in patients with limited cardiovascular reserve.

4.3 Adjuncts: Peripheral Nerve Blocks and Sedation

Peripheral nerve and fascia iliaca compartment blocks are increasingly used as analgesic adjuncts alongside either general or spinal anesthesia, and Cochrane and other systematic reviews have found that they reduce pain on movement and opioid consumption, and may reduce the incidence of delirium and other complications, largely independent of whether the primary anesthetic technique is regional or general. Because nerve blocks are frequently used as a co-intervention in both study arms of comparative trials, their analgesic benefit should be considered complementary to, rather than a substitute for, the choice between spinal and general anesthesia discussed in this review.

V. CONTEMPORARY PRACTICE PATTERNS

Despite decades of debate, national registry data show that both techniques remain in widespread use, with

practice varying by hospital, anesthetist preference and patient factors. Data from the National Hip Fracture Database (NHFD) of England, Wales and Northern Ireland — one of the largest prospective national audits of hip fracture care in the world — recorded the anesthetic technique used in 107,028 patients undergoing hip fracture surgery in 2018–2019. General anesthesia was used in 55% of patients; spinal anesthesia without sedation was used in 29%, and spinal anesthesia with sedation in a further 16%, so that regional (spinal) techniques collectively accounted for approximately 45% of cases (Figure 2). This roughly even split, sustained across a very large and representative national cohort, reflects genuine clinical equipoise rather than a settled consensus in either direction.

Anaesthetic technique used for hip fracture surgery
(NHFD England, Wales & N. Ireland, 2018–2019; n = 107,028)

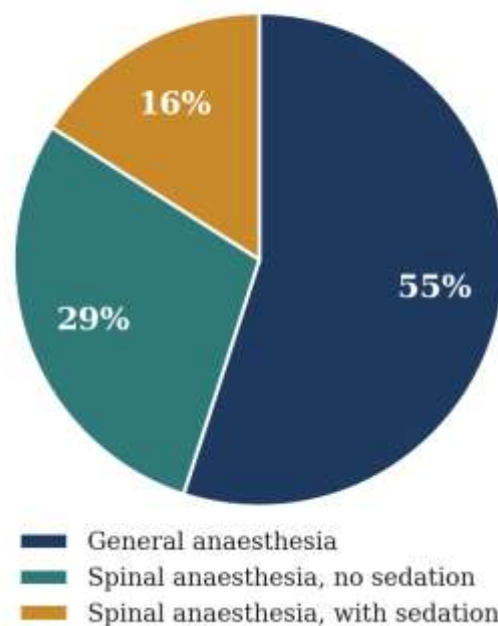


figure 2. anaesthetic technique used for hip fracture surgery in the national hip fracture database cohort of england, wales and northern ireland, 2018–2019 (n = 107,028).

table 1. characteristics of the principal comparative studies discussed in this review.

Study	Design	Sample size	Population	Comparison
Neuman et al., REGAIN Trial (2021)	Pragmatic multicentre RCT	1,600 patients (46 hospitals, US & Canada)	Age $\geq$ 50 y, surgical hip fracture, pre-fracture independent walker	Spinal vs general anesthesia
White et al., NHFD Cohort (2022)	Prospective national registry cohort	107,028 patients (England, Wales, N. Ireland)	All adults undergoing hip fracture surgery, 2018–2019	General vs spinal ($\pm$ sedation) anesthesia

van Waesberghe et al., Meta-analysis (2017)	Systematic review & meta-analysis	23 studies (3 RCTs, 20 observational)	Adults undergoing hip fracture surgery	General neuraxial anesthesia vs
Morgan et al., Database Analysis (2020)	Propensity-matched observational cohort	Large national database (UK)	Adults undergoing hip fracture repair	Spinal vs general anesthesia
Multiple RCT meta-analyses (2022–2025)	Systematic reviews & meta-analyses of RCTs	Pooled randomized trial cohorts	Older adults undergoing hip fracture surgery	Spinal vs general anesthesia

VI. EVIDENCE FROM RANDOMIZED CONTROLLED TRIALS

6.1 The REGAIN Trial

The most authoritative single source of evidence is the REGAIN trial, a pragmatic, randomized, multicentre comparison conducted at 46 hospitals in the United States and Canada. It enrolled 1,600 patients (795 assigned to spinal anesthesia, 805 to general anesthesia) with a mean age of 78 years, 76% of whom were women, who were able to walk independently before their fracture. Adherence to the assigned technique was 84% in the spinal group and 96.5% in the general anesthesia group, reflecting real-world crossover related to technical failure or patient preference. The trial's primary outcome — a composite of death or an inability to walk independently across a room without assistance at 60 days — occurred in 18.5% of the spinal group versus 18.0% of the general anesthesia group, a non-significant difference (relative risk 1.03, 95% CI 0.83–1.28), indicating that neither technique conferred a meaningful advantage for this primary, patient-centred functional outcome (Table 2).

table 2. key outcomes of the regain trial comparing spinal and general anesthesia for hip fracture surgery (neuman et al., 2021).

Outcome	Spinal anesthesia	General anesthesia	Comparative result
Primary composite: death or inability to walk independently at 60 days	18.5% (132/712)	18.0% (132/732)	RR 1.03 (0.83–1.28)
60-day mortality	3.9%	4.1%	No significant difference
In-hospital mortality	0.6%	1.6%	Lower with spinal
Postoperative delirium	20.5%	19.7%	No significant difference
Severe pain, first 24 hours	Higher	Reference	Greater with spinal

Analgesic use at 60 days	25.0%	18.8%	Higher with spinal
Length of hospital stay	Similar	Similar	No systematic difference

A pre-specified long-term follow-up of the REGAIN cohort extended assessment of survival and functional status beyond the initial 60-day window and similarly found no clinically important difference in longer-term mortality or walking ability between the two anesthesia groups, reinforcing the trial's central message that the choice of anesthetic technique does not, in itself, determine whether a patient survives or regains independent mobility after hip fracture surgery.

6.2 Earlier and Smaller Randomized Trials

Before REGAIN, the RCT evidence base consisted mainly of small, single-centre trials, individually underpowered to detect differences in mortality or major morbidity, though collectively suggestive of secondary benefits with spinal anesthesia such as reduced blood loss and intraoperative haemodynamic advantages in selected subgroups. Meta-analyses pooling these earlier randomized trials alongside REGAIN have generally converged on the same conclusion as REGAIN itself for hard outcomes — no significant difference in short-term mortality — while noting continued heterogeneity in how delirium, pain and functional outcomes were measured across studies, which limits the precision of pooled estimates for these secondary endpoints.

VII. EVIDENCE FROM OBSERVATIONAL AND REGISTRY STUDIES

7.1 The NHFD Cohort Study

Because randomized trials such as REGAIN, however large, cannot capture the full diversity of real-world practice, large registry-based cohort studies provide an important complementary perspective. The National Hip Fracture Database analysis of 107,028 patients found no significant difference in 30-day mortality between spinal and general anesthesia overall (odds ratio 1.03, 95% CI 0.98–1.09), consistent with REGAIN. However, several secondary outcomes favoured spinal anesthesia: length of hospital stay was shorter by a mean of 0.46 days (95% CI –0.66 to –0.26; $p < 0.001$), the odds of returning to the patient's original place of residence were modestly higher (OR 1.04, 95% CI 1.01–1.06; $p = 0.013$), and the odds of postoperative delirium, assessed using the 4AT screening tool, were modestly lower (OR 0.96, 95% CI 0.94–0.99; $p = 0.007$). When the spinal-without-sedation subgroup was analysed separately against general anesthesia, day-one mobilisation was also significantly more likely (OR 1.06, 95% CI 1.02–1.10; $p = 0.004$), suggesting that the addition of sedation to a spinal technique may attenuate some of its early functional advantages.

7.2 Meta-Analyses of Observational Data

A widely cited systematic review and meta-analysis by van Waesberghe and colleagues pooled 23 studies (3 randomized and 20 observational) comparing general with neuraxial anesthesia. It found no significant difference in 30-day mortality (odds ratio 0.99, 95% CI 0.94–1.04), but a significant reduction in in-hospital mortality with neuraxial anesthesia (odds ratio 0.85, 95% CI 0.76–0.95; $p = 0.004$), alongside a modestly shorter length of hospital stay (mean difference –0.26 days, 95% CI –0.36 to –0.17; $p < 0.00001$). A separate propensity-matched national database analysis by Morgan and colleagues similarly reported small but statistically detectable differences favouring spinal anesthesia on selected morbidity outcomes after adjustment for measured confounders, while cautioning, as is inherent to observational

designs, that residual confounding by indication cannot be fully excluded — sicker or less mobile patients may be systematically directed toward general anesthesia because they cannot cooperate with positioning for a spinal block, which would bias observational comparisons in favour of the regional technique even if no true causal benefit exists.

VIII. SYNTHESIS OF COMPARATIVE OUTCOMES

Taken together, the RCT and observational evidence converge on a consistent overall pattern, illustrated as a forest-plot-style summary in Figure 3 and tabulated in Table 3: for the hardest, least biasable outcomes — 30/60-day mortality and the composite of death or inability to walk independently — regional and general anesthesia are essentially equivalent, with point estimates close to 1.0 and confidence intervals that comfortably span unity. For softer, though still clinically meaningful, secondary outcomes — in-hospital mortality, postoperative delirium, length of stay, day-one mobilisation and return to original residence — the evidence leans, modestly but fairly consistently, in favour of regional/spinal anesthesia, with effect sizes that are statistically significant in large cohorts but individually small in absolute magnitude.

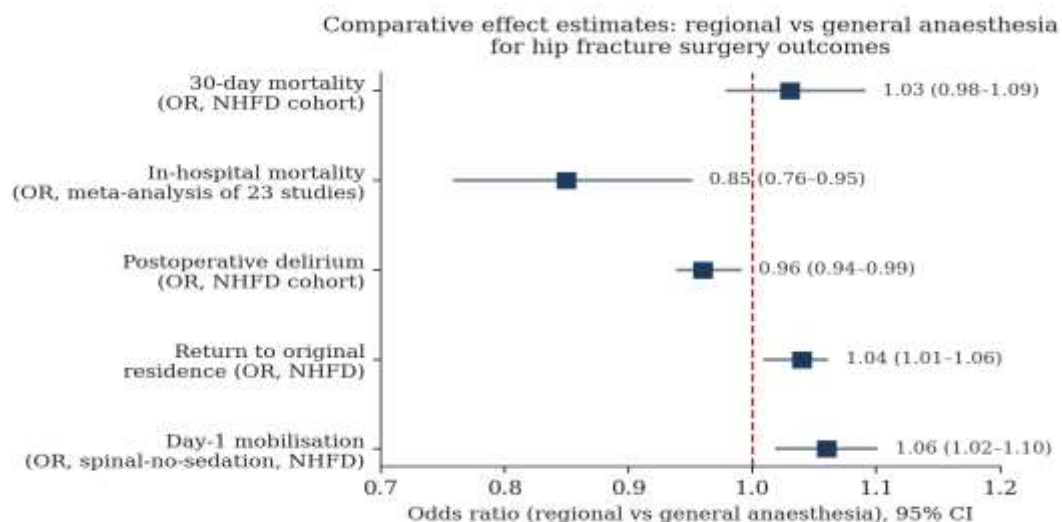


figure 3. comparative effect estimates (odds ratios with 95% confidence intervals) for regional versus general anesthesia across key hip fracture surgery outcomes, drawn from the regain trial, the nhfd cohort, and a 23-study meta-analysis.

8.1 Mortality

No study reviewed here — randomized or observational — has demonstrated a statistically robust difference in 30- or 60-day all-cause mortality between spinal and general anesthesia when analysed on an intention-to-treat or comparably rigorous basis. The one recurring exception is in-hospital mortality, which several observational analyses (though not REGAIN, where the absolute number of in-hospital deaths was small) found to be somewhat lower with regional techniques; this discrepancy between in-hospital and 30/60-day mortality estimates likely reflects both the smaller number of in-hospital events available to randomized trials and possible confounding in observational cohorts, and should be interpreted cautiously rather than as evidence of a true survival benefit.

8.2 Postoperative Delirium and Cognitive Outcomes

Delirium is one of the most extensively studied secondary outcomes in this literature, reflecting long-standing hypotheses that general anesthesia, through mechanisms such as neuroinflammation, cerebral

hypoperfusion and the pharmacological burden of volatile agents and systemic opioids, might predispose to acute postoperative confusion. REGAIN itself found no significant difference in delirium incidence between arms (20.5% spinal vs 19.7% general), whereas the much larger NHFD cohort found a small but statistically significant reduction in delirium odds with spinal anesthesia (OR 0.96, 95% CI 0.94–0.99), and this direction of effect — a modest delirium benefit for regional techniques — has recurred in several more recent systematic reviews and meta-analyses of both randomized and observational studies published since 2022. The apparent inconsistency between REGAIN and the larger pooled analyses most plausibly reflects statistical power: an odds ratio of the magnitude reported in the NHFD cohort would require a considerably larger sample than REGAIN to detect reliably.

8.3 Length of Stay, Mobilisation and Return to Residence

Across data sources, spinal anesthesia has been associated with a modestly shorter length of hospital stay — a mean reduction on the order of a quarter to half a day in the two largest analyses reviewed here (Figure 4) — together with a higher likelihood of achieving day-one mobilisation and of being discharged back to the patient's original place of residence rather than to a higher level of institutional care. These differences, while individually small, are clinically relevant at a population level given the very large number of hip fractures treated annually, and are broadly consistent with the biological plausibility that avoiding general anesthesia and its associated sedative hangover may facilitate earlier engagement with physiotherapy.

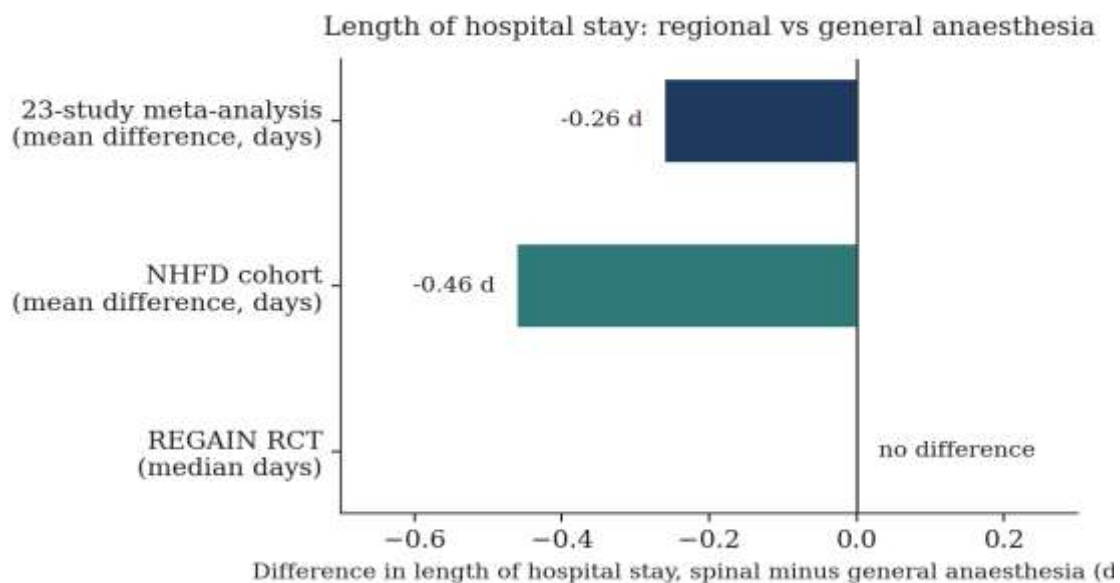


figure 4. difference in mean length of hospital stay (spinal minus general anaesthesia) reported across the regain trial, the nhfd cohort and a 23-study meta-analysis.

8.4 Pain and Analgesic Requirements

A consistent and clinically important finding across trials, including REGAIN, is that patients who receive spinal anesthesia tend to experience greater pain in the first 24 postoperative hours, once the block has worn off, than those who received general anesthesia with multimodal analgesia established intraoperatively; this difference generally resolves within the first few days but is associated with somewhat higher rates of analgesic use persisting to 60 days in some cohorts. This finding argues strongly for proactive, multimodal postoperative analgesia — including peripheral nerve blocks — to be planned in advance for patients receiving spinal anesthesia, rather than being treated as an afterthought once the block recedes.

table 3. summary of pooled directional findings for regional versus general anesthesia across evidence sources.

Outcome	REGAIN (RCT)	NHFD (n=107,028)	23-study meta-analysis
30/60-day mortality	No difference	No difference	No difference
In-hospital mortality	Lower with spinal (few events)	Not separately reported	Lower with regional (OR 0.85)
Postoperative delirium	No difference	Lower with spinal (OR 0.96)	Favours regional (multiple reviews)
Length of stay	Similar	Shorter with spinal (−0.46 d)	Shorter with regional (−0.26 d)
Early mobilisation	Not primary endpoint	Higher with spinal, no sedation	Not consistently reported
Return to original residence	Not primary endpoint	Higher with spinal (OR 1.04)	Not consistently reported
Early postoperative pain	Greater with spinal (0–24 h)	Not reported	Not consistently reported

IX. PERIOPERATIVE AND PRACTICAL CONSIDERATIONS

9.1 Haemodynamic Stability and Blood Loss

Spinal anesthesia produces sympathetic blockade that can precipitate clinically significant hypotension, particularly in older patients with limited cardiovascular reserve, pre-existing autonomic dysfunction, or hypovolaemia from occult fracture-site blood loss; careful dosing, fluid management and vasopressor support are therefore integral to its safe use in this population. Conversely, several comparative studies have reported modestly lower intraoperative blood loss with spinal compared with general anesthesia, plausibly related to lower venous pressure in the surgical field under neuraxial block, although this has not translated consistently into differences in transfusion rates across all cohorts.

9.2 Anticoagulation and Antiplatelet Therapy

A substantial proportion of patients presenting with hip fracture are established on anticoagulant or antiplatelet therapy for atrial fibrillation or other indications, which materially affects anesthetic choice. Current perioperative guidelines set defined intervals between the last dose of anticoagulant and neuraxial puncture to minimise the risk of spinal or epidural haematoma; when these intervals cannot be safely achieved without unacceptable delay to surgery — itself associated with worse outcomes in hip fracture care — general anesthesia is often the pragmatic default. This consideration means that, in practice, the two techniques are frequently not interchangeable for a given patient at a given point in time, and comparative outcome data should be interpreted as applying to patients in whom either technique was a clinically reasonable option.

9.3 Cognitive Impairment and Patient Cooperation

Successful spinal anesthesia requires the patient to cooperate with positioning, however briefly, despite an acutely painful fracture, and many hip fracture patients have pre-existing cognitive impairment or delirium at presentation that limits this cooperation. In such patients, general anesthesia may be the only

practically feasible option regardless of any theoretical outcome advantage of the regional technique, again constraining the population in whom a genuine choice exists and for whom the comparative evidence reviewed here is most directly applicable.

9.4 Cost and Resource Use

Economic analyses comparing the two techniques have generally suggested that spinal anesthesia is associated with modestly lower direct costs per case than general anesthesia, driven largely by reduced use of disposable airway equipment, volatile agents, and post-anesthesia recovery time, alongside the shorter hospital stay noted above; however, these cost differences are sensitive to local staffing models, block-room availability, and the additional anesthetist time sometimes required to place a spinal block in a frail, painful patient, and should be interpreted as institution-specific rather than universally generalisable.

X. DISCUSSION

The accumulated evidence reviewed here does not support a categorical claim that either regional or general anesthesia is superior for hip fracture surgery in older adults. For the outcomes that matter most to patients and families — survival and the ability to walk independently — the two techniques appear essentially equivalent, a conclusion now anchored by a definitive, adequately powered, multicentre randomized trial (REGAIN) rather than resting solely on smaller trials or observational data prone to confounding. This equivalence for hard outcomes is itself clinically useful information: it means that anesthetic technique need not be treated as a life-or-death decision, and that other, more patient-specific factors can and should dominate the choice.

At the same time, a reasonably consistent secondary signal favours regional anesthesia for delirium, length of stay, early mobilisation and return to original residence — outcomes that, while individually modest in effect size, are important drivers of quality of life and of the burden placed on health and social care systems, especially given the sheer scale of the global hip fracture burden projected to grow substantially over coming decades. This pattern is biologically plausible (avoidance of airway instrumentation, reduced sedative burden, earlier alertness for physiotherapy) but has not been proven causal by REGAIN itself, and observational sources carry an inherent risk of confounding by indication, since the patients most able to cooperate with and benefit from a spinal block may differ systematically from those who cannot.

A further consistent finding — greater early postoperative pain with spinal anesthesia — is a reminder that neither technique is free of drawbacks, and that the anesthetic plan should be considered alongside, rather than instead of, a robust multimodal analgesic strategy, ideally incorporating peripheral nerve or fascia iliaca blocks regardless of the primary technique chosen. Taken as a whole, the literature supports a model of individualised, shared decision-making: general anesthesia should generally be favoured when spinal anesthesia is anatomically difficult, contraindicated by recent anticoagulation, or not tolerable because of cognitive impairment or inability to position, while spinal anesthesia is a reasonable, evidence-supported default when none of these constraints apply and the patient, once informed of the trade-off in early postoperative pain, expresses no preference against it. Integration of anesthetic planning within orthogeriatric co-management pathways, which are already associated with improved outcomes in hip fracture care more broadly, offers a natural framework in which this individualised decision can be made promptly, without contributing to surgical delay, itself a well-established driver of worse outcomes in this population.

XI. LIMITATIONS OF THE CURRENT EVIDENCE BASE

Several limitations temper the conclusions of this review. First, as a narrative rather than a fully systematic review, study selection, while guided by an explicit search strategy and a preference for the largest and most rigorous sources, was not exhaustive and was not subject to formal risk-of-bias scoring; a dedicated systematic review or updated Cochrane analysis remains the appropriate reference standard for readers requiring a fully quantitative, bias-assessed synthesis. Second, even the REGAIN trial, despite its size, excluded patients unable to walk independently before fracture and those in whom either technique was contraindicated, so its findings may not generalise fully to the frailest, most cognitively impaired patients who are, paradoxically, often those in whom the anesthetic decision is most consequential. Third, observational cohorts, however large, remain vulnerable to confounding by indication, and reported associations — particularly the delirium and length-of-stay findings — should be regarded as hypothesis-supporting rather than definitively causal. Fourth, outcome definitions (particularly for delirium, which has been assessed using varying screening instruments across studies) are not fully standardised across the literature, which may contribute to between-study heterogeneity in pooled estimates. Finally, most large comparative studies to date have been conducted in North American and European healthcare systems; evidence from other regions, including South Asia, where the burden of hip fracture is projected to grow most rapidly, remains comparatively limited.

XII. FUTURE RESEARCH DIRECTIONS

Priorities for future research include long-term (beyond one year) functional and cognitive follow-up of large randomized cohorts such as REGAIN; adequately powered trials or pooled analyses specifically targeting delirium as a primary rather than secondary outcome, using standardised, validated assessment tools; pragmatic trials embedded within orthogeriatric care pathways that capture real-world decision-making constraints such as anticoagulation and cognitive status; economic evaluations conducted across a range of healthcare systems, including low- and middle-income settings bearing a rapidly growing share of the global hip fracture burden; and implementation research examining how shared decision-making about anesthetic technique can be operationalised without contributing to delays to surgery.

XIII. CONCLUSION

Hip fracture surgery in older adults is one of the most common major operations performed worldwide, and its burden is projected to grow substantially as populations age. The best available evidence — anchored by the large, pragmatic REGAIN randomized trial and corroborated by a 107,028-patient national registry cohort and multiple systematic reviews — indicates that regional (spinal) and general anesthesia produce essentially equivalent outcomes for survival and the recovery of independent walking ability, while regional anesthesia is associated with modest, fairly consistent secondary advantages in postoperative delirium, length of hospital stay, early mobilisation and return to original residence, at the cost of greater early postoperative pain. Neither technique should be regarded as uniformly superior; rather, the anesthetic plan should be individualised according to spinal anatomy, anticoagulation status, cognitive status and patient preference, embedded within a multimodal analgesic strategy and a timely, collaborative orthogeriatric care pathway that avoids delay to surgery regardless of which anesthetic technique is ultimately selected.

XIV. ACKNOWLEDGMENT

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