Improving morbidity and mortality in hip fragility fractures

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Purpose of review
Hip fragility fractures (HFF) carry high morbidity and mortality for patients and will increase in frequency and in proportion to the average patient age. Provision of effective, timely care for these patients can decrease their morbidity and mortality and reduce the large burden they place on the healthcare system.

Recent findings
There are associative relationships between prefracture frailty, postoperative delirium and increased morbidity and mortality. The use of a multidisciplinary approach to HFF care has shown improved outcomes in care with focus on modifiable factors including admission to specialty care floor, use of peripheral nerve blocks preoperatively and Anesthesia and Physical Therapy involvement in the care team. Peripheral nerve blocks including pericapsular nerve group (PENG) blocks have shown benefit in lowering morbidity and mortality.

Summary
HFF are associated with >40% chance of continued pain and inability to return to prefracture functional status at 1 year as well as >30% mortality at 2 years. In this opinion piece, we will discuss how a multidisciplinary approach that includes Anesthesia as well as utilization of peripheral nerve blocks can help to lessen postoperative issues and improve recovery.

Keywords
hip fragility fractures, orthopedic multidisciplinary team, pericapsular nerve group block, regional anesthesia

INTRODUCTION

Geriatric hip fractures due to osteoporosis, also known as hip fragility fractures (HFF), are currently a prominent and burdensome issue facing the United States and international healthcare systems. With a growing population of elderly patients, the prevalence of chronic conditions amplifies the probability of frailty which increases both the risk of falls [1] and the risk of mortality and morbidity from HFF [2]. Preoperative frailty was also found to have a correlative relationship with postoperative delirium [3▪], which in turn was found to have an associative relationship with adverse medium to long term outcomes [4▪]. It is estimated that the number of geriatric patients at high risk for HFF will double from 150 million in 2010 to over 300 million in the year 2040 [5]. These statistics warrant prioritization of evidence-based management to optimize outcomes. Perioperative care of this population has the potential for long-term effects on patients, their families, and the healthcare system.

Morbidity and mortality with HFF remains high despite advances in care over recent years. A study in 2021 found the 2-year mortality of HFF to be 32.7% [6], while a more recent study in 2023 in mainland China found a ninefold increase in mortality for patients who had a HFF compared to the general population [7▪]. Additionally, multiple studies show high levels of morbidity with HFF including pain at 1 year in 49% of patients [8], failure to return to previous ambulatory status in 40–79% of patients [9] and fracture risk to the contralateral hip of almost 13% over the 10 years post initial fracture [10]. In 2022, Lim *et al.* [11] also found that >30% of patients were unable to return to their prefracture

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KEY POINTS

- Hip fragility fracture (HFF) is a common injury with high morbidity and mortality associated with increased age, preoperative frailty and postoperative delirium.
- On-site specialists, early discussion regarding treatments plans, timely use of peripheral nerve blocks and surgical intervention in less than 24 h can decrease mortality and morbidity in these patients.
- Regional anesthesia has been proven to aid in pain control and decrease narcotic requirements lowering the risk of postoperative delirium and other adverse effects in patients with HFF.
- Protocol development and standardization of care with involvement of emergency department physicians, orthopedic surgeons, anesthesiologists in coordination with hospital leadership improves care of these patients.
- Ideal regional anesthetic technique depends on many factors including location of fracture, surgical approach, provider skill level and timing to surgical intervention.

living arrangement and almost half (36/77) of the families surveyed reported additional financial stress to the household after the fracture. All these postfracture consequences lead to a large burden to the patient, their families, and the healthcare system as a whole. Implementation of appropriate perioperative management may decrease these stressors by improving both morbidity and mortality of HFF.

PERIOPERATIVE MANAGEMENT

There is considerable debate around anesthetic choice, intra-operative management, and the effect on outcomes when it comes to HFF. The oft quoted RAGA trial found no significant reduction in delirium between spinal anesthesia with no sedation compared to general anesthesia; however the trial was underpowered with a different population and cultural context [12]. The difference in culture matters given that the incidence of postoperative delirium is significantly lower in the Chinese population compared to the Western population at baseline. This could have been in part due to the study population originating from rural China where frailty scores are typically lower [13] and the cultural norm of close involvement of family in the postoperative state [14]. The trial's observed incidence of delirium was even lower leading to the study's lack of power to achieve the anticipated 30% relative reduction. The REGAIN trial found that the incidence of death or new inability to ambulate 60 days after surgery did not differ significantly between spinal anesthesia (with sedation) and general anesthesia; nor did secondary outcomes which included delirium [15]. This study was also underpowered with high heterogeneity. Since the goal was to maintain 'typical practice' there was high variability in sedation regimens which likely decreased the ability to detect differences in general anesthesia versus spinal anesthesia. Nonadherence to the assigned treatment due to conversion from spinal to general anesthesia also contributed to the reduction in power. An observational study found general anesthesia and conversions from regional to general anesthesia were associated with worse outcomes, but could not account for confounding variables [16]. The REGAIN and RAGA studies, while often used to justify choice of anesthetic, lack the power to definitively say one anesthetic is superior to the other. Matharu *et al.* [17▪▪] found that spinal anesthesia without sedation was associated with 'improved perioperative outcomes – including a reduced risk of delirium, an increased likelihood of mobilization by the day after hip fracture surgery, an increased likelihood of returning to admission residence on discharge, and a shorter length of hospital stay'. The study admits that this does not confer causality given that other important variables (frailty, comorbidities, specifics about the anesthetics) that could have affected outcomes were not adjusted for and ultimately states that their data is 'suggestive but inconclusive.'

In the end, anesthetic choice is a complex decision based on provider ability, patient comorbidities including anticoagulation status, cardiac function, spinal column assessment, patient preference, airway assessment and surgery limitations. That being said, it is prudent to maintain anesthetic goals of adequate analgesia (ideally with a peripheral nerve block), hemodynamic stability, avoidance of ischemia and hypoxia and limiting use of centrally acting drugs. Optimization of care with a goal of minimizing postoperative delirium is recommended [4▪]. If spinal anesthesia is utilized, depth of sedation should be carefully monitored. Further studies are warranted to ascertain optimal levels of sedation for spinal anesthetics in these patients.

The return to prefracture functional status is the goal for patients, families, and perioperative teams and unsurprisingly, the pursuit of this goal is associated with a reduction in mortality and morbidity. Perioperative teams should focus on protocols and standardization that prioritize and provide expert care, decreased time before and during surgery, adjusted anesthetic plans to limit hemodynamic alterations and centrally acting drugs that would

affect cognitive abilities, and postoperative care with a focus on remobilization and rehabilitation soon after surgery [18]. HFF patients benefit from a proactive, standardized multidisciplinary approach in a center with the expertise, equipment and support to manage this vulnerable population [19▪▪]. On-site specialists, early discussion regarding treatments plans, timely use of peripheral nerve blocks and surgical intervention in <24 hours affect both outcomes and posthospital placement. Early communication between the Emergency Room, Orthopedic Surgery, Anesthesia and Primary Care allows for timely ordering and coordination of imaging, bloodwork, analgesia, operating room time and early mobilization [20]. Departmental and hospital leadership involvement is paramount in standardization and protocol development. In addition to the above, one study found further modifiable factors contributed to improved outcomes: direct admission to specialized hip fragility ward, early discussion of treatment plans, preoperative use of nerve blocks, point of care hemoglobin testing, preoperative pain scores, appropriate use of total hip replacements, monthly clinical governance meetings attended by surgery, anesthesia and physical therapy and readily available audit data to guide decisions [19▪▪]. The multitier and multidisciplinary approach illuminate the value each piece contributes to patient outcomes.

REGIONAL ANESTHESIA

The use of regional anesthesia for hip fractures has garnered considerable attention with multiple studies in favor for its employment. One review article looking at 49 different studies showed that patients that received peripheral nerve blocks had reduction in pain scores, reduced confusion, and reduced time to first mobilization [21]. Another review of 12 trials comparing ultrasound guided blocks to systemic analgesia showed decreased pain, with coinciding decreased morphine equivalent consumption, lower frequency of delirium, and higher patient satisfaction in patients receiving regional anesthesia [22▪▪]. Local anesthetics have a role outside of the operating room as well; Emergency Medicine physicians have also been evaluating the efficacy of regional anesthesia in hip fractures finding that block patients had less pain with movement, lower opioid requirements, and decreased risk of delirium [23]. Peripheral nerve blocks tend to reduce pain scores, lessen opioid requirements, and improve satisfaction scores in patients with hip fractures.

The decision to employ regional anesthesia is not a binary one and the block choice is often complex relying on knowledge of patient anatomy, surgical approach, anticoagulation and staff and equipment capabilities. Lumbar plexus, femoral nerve, quadratus lumborum (QL), fascia iliaca compartment (FICB), and pericapsular nerve group (PENG) blocks have all been studied and validated for patients who present with hip fractures. Hip joint innervation comes from the lumbar and sacral plexuses (Fig. 1). The sciatic, obturator, and femoral nerves cover much of the innervation of the joint with cutaneous additions from lateral femoral cutaneous nerve and genitofemoral nerve [24]. The ideal regional technique would cover all the sensory components without motor involvement to encourage early mobility.

Lumbar plexus block

The Lumbar Plexus innervates a portion of the hip joint and therefore is a location for regional block option for hip fractures. The lumbar plexus block is a deep nerve block making it technically difficult and requiring a skilled and experienced provider. Due to limitations in compressibility of vasculature in the area, it is often considered akin to a neuraxial technique with many providers following the same anticoagulation guidelines. This proximity to the patient's spinal cord (Fig. 1) and vasculature, while providing excellent analgesia, also risks dural puncture, neuraxial spread of local anesthetic, vascular uptake and sympathectomy.

It was traditionally performed as a landmark based block utilizing only nerve stimulation, but dual use of ultrasound guidance can improve the safety profile and success rate [24]. The use of needle stimulation confirmed accurate needle placement based on observed motor stimulation of the femoral nerve supplying the quadratus femoris muscle group leading to brief, but increased discomfort in patients with hip fractures. Once in place the lumbar plexus block has been shown to provide good postoperative analgesia for patients with hip fractures [25]. Despite the benefits of this block, it has fallen out of favor in many practices for blocks with easier techniques and better safety profile.

Femoral nerve block

The femoral nerve derives from the lumbar plexus (L2–L4) providing sensory components to the hip joint along with motor and sensory to the anterior thigh (Fig. 1). Femoral nerve block tends to be a fairly shallow block in most patients that can be easily performed with landmarks, ultrasound (Fig. 2), and/or peripheral nerve stimulation [24]. The patient is positioned supine for this block making it ideal for a patient with a painful hip fracture.

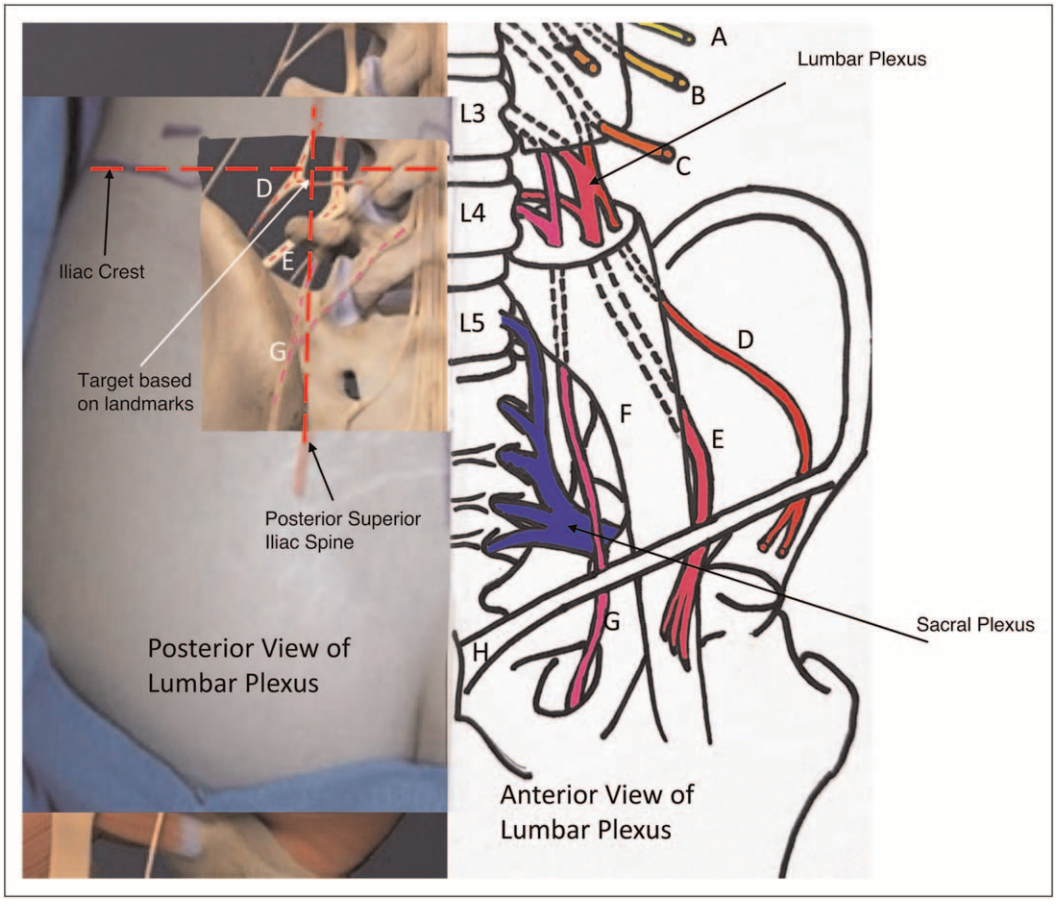

FIGURE 1. Anterior (R) and Posterior (L) views of Lumbar Plexus. (a) Iliohypogastric Nerve (b) Ilioinguinal Nerve (c) Genitofemoral Nerve (d) Lateral Femoral Cutaneous Nerve (e) Femoral Nerve (f) Psoas Muscle (g) Obturator Nerve (h) Inguinal Ligament.

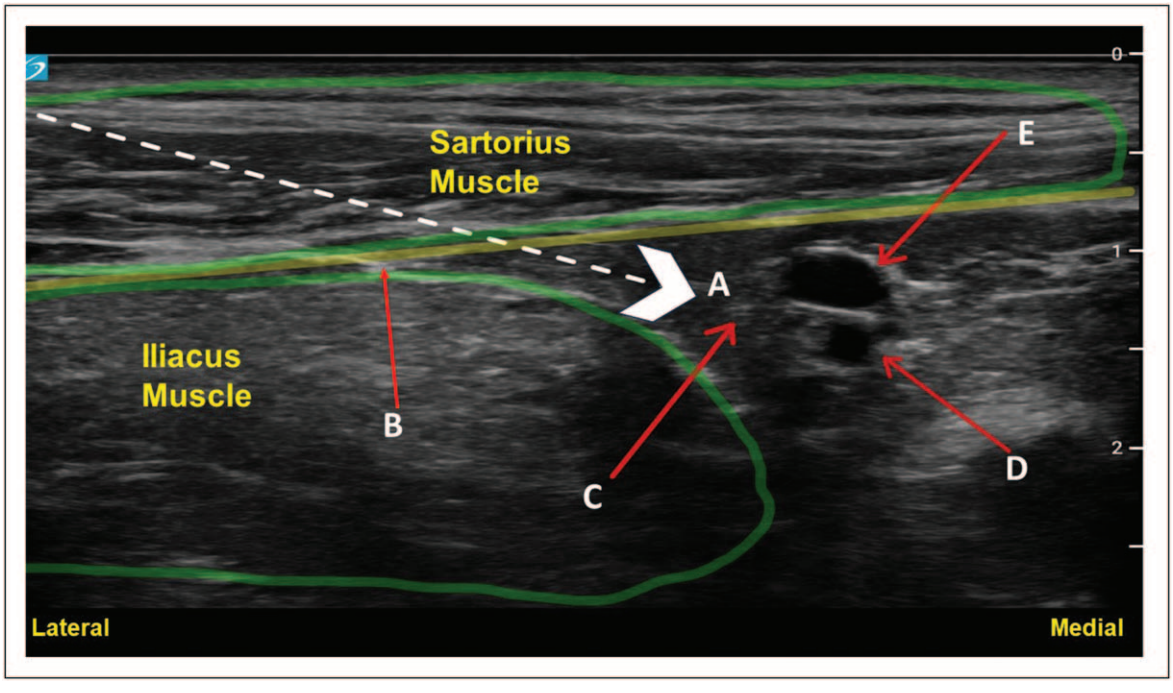

FIGURE 2. Ultrasound image of femoral nerve. (a) Target for local anesthetic deposition. (b) Fascia lata. (c) Femoral nerve. (d) Femoral artery. (e) Femoral vein. Dotted line: needle trajectory.

Traditional femoral nerve block has been proven to significantly improve pain scores including during manipulation for X-ray and traction [26]. The three-in-one femoral nerve block as performed by Emergency medicine providers also significantly decreased pain intensity in patients with hip fractures [27]. This block is described in several emergency medicine articles as femoral nerve block with volume 25 ml followed by manual pressure applied 1 cm below injection to facilitate cephalad spread with the goal to cover obturator and lateral femoral cutaneous nerves as well. In this case the means may not justify the ends given that manual pressure near a hip fracture in a frail patient is likely less than appealing to them or their family.

Fascia iliaca compartment block

Fascia iliaca compartment block (FICB) is deposition of local anesthetic deep to the fascia iliaca which allows spread to lateral femoral cutaneous, obturator, and femoral nerves. It can be performed with loss of resistance technique or with ultrasound as either supra-inguinal or infra-inguinal approaches [24]. FICB is performed with patient supine, tends to be a superficial target and similar to other fascial plane blocks relies of higher volumes for success. This block acts similarly to an anterior lumbar plexus block with a higher safety profile.

Quadratus lumborum block

The QL block is an abdominal fascial plane block which can provide some sensory analgesia for hip surgeries. QL blocks have been shown to be effective analgesia for various hip surgeries [28▪] with sensory coverage that tends to avoid motor involvement [29]. The QL block can be performed supine and is typically done with ultrasound guidance (Fig. 3). This technique will often miss certain nerve branches providing innervation to the hip joint [24].

Pericapsular nerve group block

The PENG block covers the articular branches of the femoral, obturator, and accessory obturator nerves [24]. Performed under ultrasound guidance, the patient is positioned supine (Fig. 4). Palpation of the anterior superior iliac spine allows for accurate placement of the ultrasound probe. Successful local anesthetic injection occurs deep to the Psoas tendon without spread to the femoral nerve and thus providing sensory blockade while avoiding motor

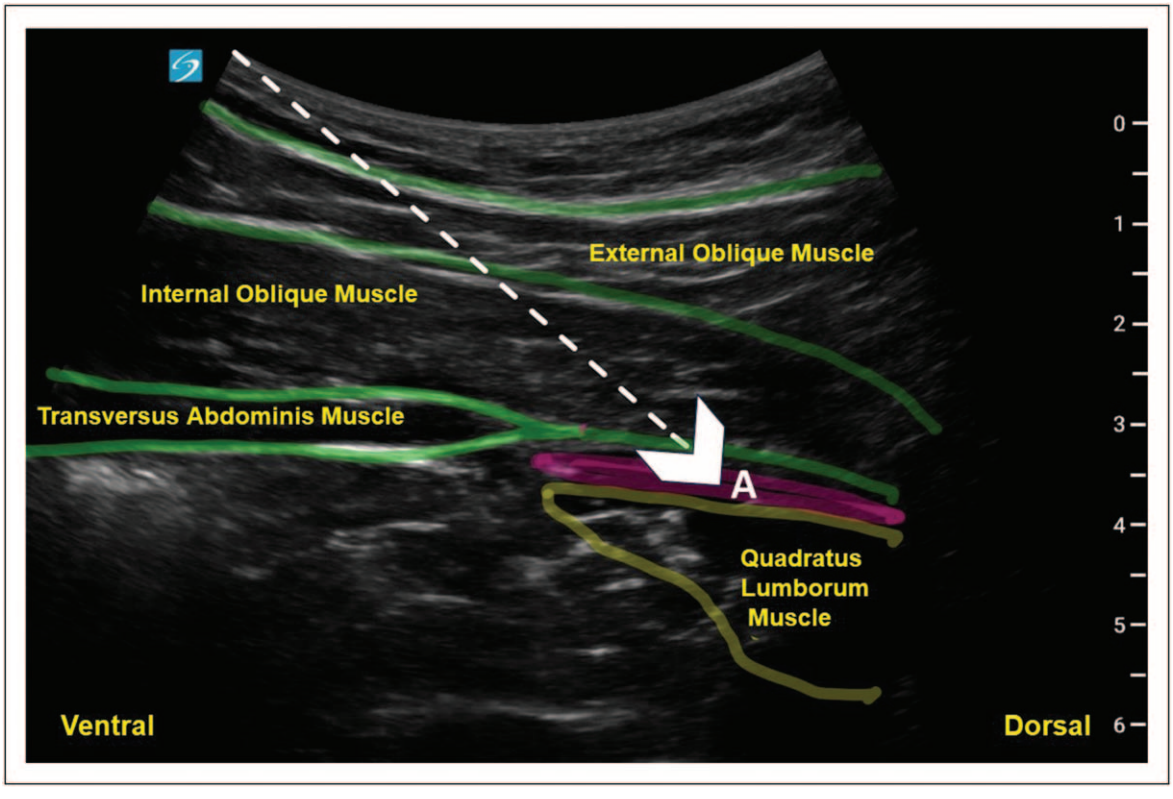

FIGURE 3. Ultrasound image of quadratus lumborum plane. Target for local anesthetic deposition. Dotted line: needle trajectory.

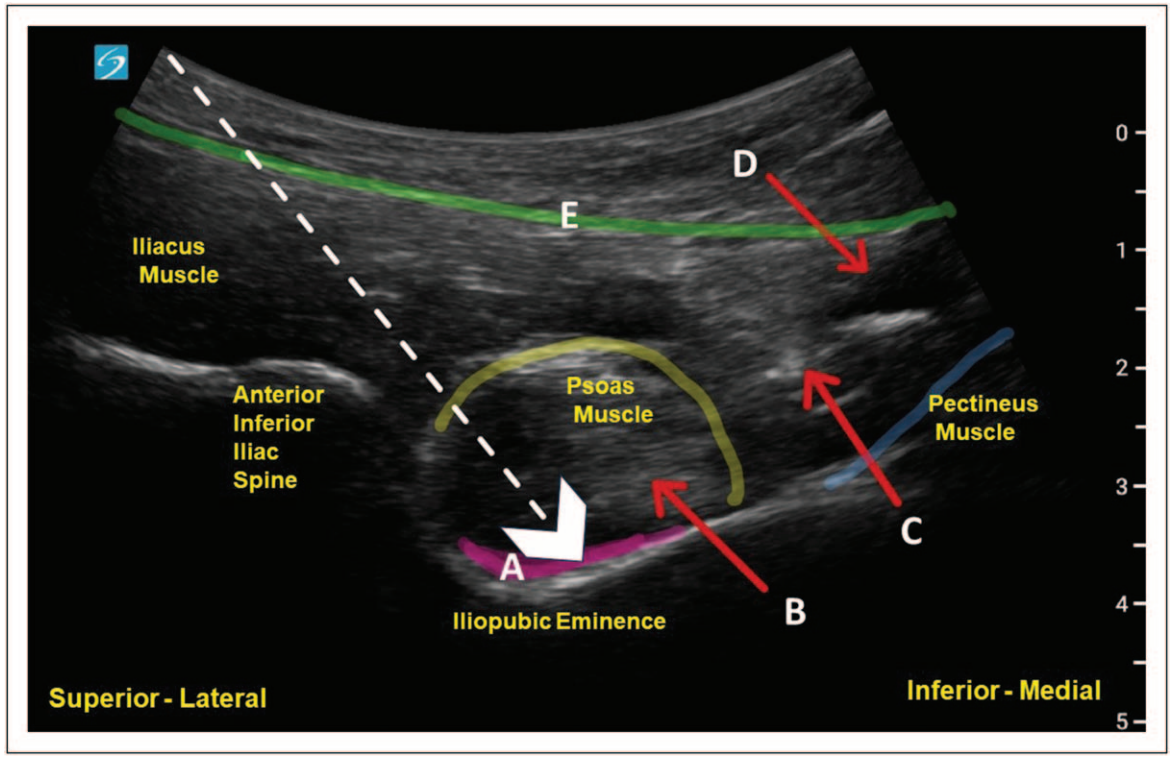

FIGURE 4. Ultrasound image of pericapsular nerve group. (a) Target for local anesthetic deposition. (b) Psoas tendon. (c) Femoral nerve. (d) Femoral artery. (e) Fascia lata. Dotted line: needle trajectory.

weakness. PENG is a novel technique that shows promise reducing pain scores without quadriceps' muscle weakness [30]. This block alone does not provide sufficient analgesia for the entire hip joint with cutaneous components and is often used in combination with other blocks [24].

CONCLUSION

As per the 2020 United States Census, the population age 65 and over experienced its largest 10-year numeric gain and fastest growth rate of any decade since 1880. This growth rate is not projected to slow until after 2030. Standardization of care guided by evidence-based medicine with a multidisciplinary team with expertise has proved beneficial to HFF patients. While definitive research regarding choice of anesthetic is lacking, there is much to suggest that limiting length and depth of sedation, avoiding centrally acting drugs, and providing adequate analgesia via peripheral nerve blocks can decrease the risk of postoperative delirium potentially lowering morbidity and mortality.

Regional anesthesia should be performed early by a skilled provider and single injections can be safely performed in emergency department [31]. Timing of these interventions should be part of the multidisciplinary protocol creation and dependent on patient presentation, comorbidities, and time to the operating room. If surgery is imminent, the regional anesthesiologist should control all local anesthetic injections, whether in spinal or peripheral nerve block, in order to optimize analgesia and decrease the risk of overdose. If surgery is unlikely to proceed within the next 12 h and the patient would benefit from regional anesthesia, blocks should be performed in the Emergency Department by either an Anesthesiologist or Emergency Physician to minimize requirement of pharmacologic interventions that increase the risk of delirium. A shorter acting regional technique used in the Emergency Department would allow the Anesthesiologist to provide timely and longer acting analgesia closer to operative time via a single shot block with longer acting drugs or placement of a peripheral nerve block catheter. Preoperative protocol creation for HFF patients would include active communication between teams, medical management including labs and orders with timely and accurate documentation, priority scheduling for the operating room and multimodal pain management accounting for timing, medications, location, and designated team performing the regional anesthetic.

These patients pose a burden on healthcare systems with high morbidity and mortality rates. Although no approach has been shown to be perfect, patient specific factors can help guide the best

anesthetic for the individual. Peripheral nerve blocks have been shown to help improve pain scores, reduce opioid consumption, and should be considered when feasible. Anesthesiologists can impact outcomes with intra-operative anesthetic management and regional anesthesia techniques, lowering the risk of postoperative delirium which in turn affects morbidity and mortality. Anesthesiologists have a long history of prioritizing safety within the operating rooms and can offer insight into the multidisciplinary protocol creation that would lead to improved outcomes for these patients.

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Conflicts of interest

There are no conflicts of interest.

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