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Retrospective Study of Anesthesia and Surgery of Femur Fracture in 74 Centenarians from 2010 to 2019. Could it be a Blue Zone in the State of Paraíba, Brazil?

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Introduction

In this year of 2024, in all countries the number of centenarians is expected to be approximately 573,000 of both sexes, and the largest number of around 97,000 centenarians are found in the United States [1]. The last census carried out in 2022 in Brazil, by the Instituto Brasileiro de Geografia e Estatística (IBGE) showed that there are 37.8 thousand centenarians, of which 1,330 are in the state of Paraíba, where the study was carried out [2]. In a review of the period from 2012 to 2019, through the Hospital Information System/Unified Health System (SIH/SUS-DATASUS), it was shown that the profile of hospitalizations and deaths found was predominantly female and white, with these increasing with age [3]. To evaluate the profile of femur fractures in older adults in Brazil between 2008 and 2018, with population-based time series study with data from the DATASUS, including 480,652 hospitalizations of adults from 60 years and over, with hip fracture, showed that there was a 76.9% increase in hospitalization records (an average of 5.87% per year) and an average incidence rate of 19.46 fractures for every 10,000 elderly people [4]. This study concluded that femur fracture is an important cause of mortality in the elderly, with a higher incidence in women and higher mortality in men, high cost to the system and regional differences [4]. In 2010, a project Acceleration of Total Post-Operative Recovery (ACERTO) was started at João Pessoa to accelerate postoperative recovery, as the Intensive Care Unit (ICU) had only eight beds, and all old patients with femur fractures, were admitted to the Complexo Hospitalar Mangabeira (CHM), were operated upon under spinal with morphine, urinary catheter, without fasting abbreviation and only operated if the patient was immediately admitted to the ICU for postoperative control [5].

The implementation of the project allowed a radical change in the treatment of patients over 60 years of age with femur fractures [5]. A Blue Zone is a region in the world where people are claimed to have exceptionally long lives beyond the age of 80 due to a lifestyle combining physical activity, low stress, rich social interactions, a local whole-foods diet, and low disease incidence [6]. There is no report of a Blue Zone in Brazil, but from 2010 to 2019 our group operated on and anesthetized 1,309 patients aged over 60 years [5] and 568 aged over 80 years [7], of both sexes of patients over 80 years old considered to have been born in the Blue Zone, different from this group that was born and lived in the semiarid area. After implementing a perioperative acceleration protocol (ACERTO) in 2010, this retrospective descriptive study was carried out with the aim of evaluating the clinical results in the population over 100 years old undergoing surgical treatment of femur fractures using regional anesthesia (spinal anesthesia and lumbar plexus block) over a period of 10 years.

Abbreviations: IBGE: Instituto Brasileiro De Geografia E Estatística; ICU: Intensive Care Unit; CHM: Complexo Hospitalar Mangabeira; MRI: Magnetic Resonance Imaging; PACU: Post-Anesthesia Care Unit; NIBP: Noninvasive Blood Pressure

Methods

A retrospective study was carried out between 2010 and 2019, for all patients over 100 years old undergoing corrective operations for femur fractures under regional anesthesia, all noted in an Excel spreadsheet, for later study. The protocol was registered in the Plataforma Brasil (CAAE: 09061312.1.0000.5179) and approved by the Research Ethics Committee (number 171.924). All patients or family members signed the Free and Informed Consent Form and authorization for publication in a medical journal. After admission to the emergency room, during the pre-anesthetic visit, the project to accelerate postoperative recovery was explained to the patient and family, and the patient or family member signed an informed consent form. Likewise, an authorization was signed for the use of the image during the anesthetic procedure and for subsequent publication of the case. Upon admission, all patients were checked against birth certificate documents to confirm their true age. The inclusion criteria were all elderly patients with a fracture femur, admitted to the CHM, normovolemic, without neurological disease or coagulation disorders, no infection at the lumbar puncture site, no evidence of agitation and/or delirium, no indwelling urinary catheter, hemoglobin level greater than 10 g%, anesthetized under spinal anesthesia without opioids and lumbosacral plexus block for analgesia and who were not admitted to the ICU. The CHM did not have magnetic resonance imaging (MRI) or equipment to perform echocardiography.

Thus, the elderly were evaluated jointly by a geriatrician, by the anesthesiologist responsible for the implementation of the ACERTO project, by an orthopedic surgeon, by the nursing, nutrition and social service team. This multidisciplinary team is essential for shortening fasting, shortening oral diet after surgery and for hospital discharge the day after surgery. All centenarians received food on the day before surgery, 200 mL of maltodextrin 2 to 4 h before being transferred to the operating room (OR). Surgeries were performed until 2:00 p.m., and patients were kept in the post-anesthesia care unit (PACU) until the end of the blockade effect, when they received 200 mL of maltodextrin again. If patients accepted oral feeding without nausea or vomiting, they were transferred to the ward, without intravenous hydration and with free diet allowed in the ward, and the time of discharge from the PACU and refeeding were recorded. The centenarians received standard anesthetic management. No premedication was administered, and the patient was transferred to the OR, where a 20G or 18G IV catheter was inserted, and an infusion of Ringer's lactate solution was started in parallel with 6% hydroxyethyl starch solution, and cefazolin 2 g and dexamethasone 10 mg were administered. Monitoring in the OR included continuous ECG in the CM5 position, noninvasive blood pressure (NIBP), pulse oximetry, and capnography. No patient received a urinary catheter.

After sedation with intravenous ketamine (0.1 mg/kg) and midazolam (0.5 to 1 mg), the skin was cleaned with chlorhexidine alcohol or 70% alcohol, and spinal puncture was performed with the patient sitting or lateral decubitus via the median or paramedian route in the L3-4 intervertebral space, after infiltration of the skin with 1% lidocaine. Quincke needles 25, 26 or 27G were used without an introducer. Isobaric bupivacaine 0.5%, 6–15 mg was injected. Patients were immediately placed in a supine position to begin the operation, and 15 minutes later, the cephalic spread of analgesia was assessed using the spinal needle mandrel for the pinprick test and the degree of motor blockade of the lower limbs using the modified Bromage scale. Hypotension (decrease in SBP ≥ 30%) was treated with etilefrine (2 mg IV) while bradycardia (HR ≤ 50 bpm) was treated with atropine (0.5 mg IV). At the end of the operation, patients received tenoxicam 40 mg and dipyrone 40 mg/kg in 50 mL of Ringer's solution. Postoperative analgesia was performed using anterior (inguinal) or posterior (psoas compartment) lumbar plexus block. In patients scheduled for the first surgery, the block was performed before spinal anesthesia in the ward or in the PACU. In the remaining patients, at the end of the surgical procedure in OR, while still under the effect of spinal anesthesia. During the implementation of the project, CHM did not have an ultrasound to perform blocks.

Therefore, the blockade was performed with a 50 mm needle for inguinal block or 100 mm needle for psoas compartment block, connected to a peripheral nerve stimulator (HNS 12 Stimuplex®, B. Braun Melsungen AG) regulated to release a square pulsatile current of 0.5 mA, with a frequency of 2 Hz, seeking to obtain contraction of the quadriceps femoris muscle. Once the desired contraction was achieved, 20 mL of 0.5% enantiomeric excess levobupivacaine (S75:R25) plus 20 mL of 2% lidocaine with epinephrine were injected in the block performed before the operation or 40 mL of 0.25% enantiomeric excess levobupivacaine (S75:R25) at the end of the operations. Analgesia was evaluated by the needle prick and cold test to determine

the extent of sensory block in the anterior thigh region (quadriceps femoris muscle) after the block was completed in the PACU and on the morning after the operation in the ward. The moment of the first painful complaint was noted. Patients were transferred to the room without IV hydration and received dipyrone 1 g 6/6 h and cefazolin 1 g 6/6 h. The study data were evaluated in four stages with their results according to Table 1.

Table 1: Study data evaluated in four stages and results.

Stages	Evaluation	Results
Before arrival in the OR	1) Hospitalization until the operation	1) 6 ± 4 days
	2) Number of postpones of the surgery	2) Zero
	3) Fasting time.	3) 2:42 ± 0:35 hours
During surgical procedure	1) Dose anesthetic used	1) 8.63 ± 2.03 mg
	2) Volume replacement RL	2) 1,188 ± 219 ml
	3) Need for blood replacement	3) 5 patients
	4) Hypotension and ethilephryne	4) 3 patients
	5) Bradycardia and atropine	5) Zero patients
	6) Surgical time	6) 1:28 ± 0:30 hours
In the PACU	1) Motor blocking time	1) 2:33 ± 0:44 hours
	2) Food CHO	2) 1:42 ± 0:48 hours
	3) Length of stay PACU	3) 2:04 ± 0:42 hours
	4) Feeding time in the ward	4) 6:08 ± 1:01 hours
	5) Incidence of nausea and vomiting	5) Zero patients
Ward morning 1st PO day	1) Duration of analgesia	1) 22.02 ± 3.30 hours
	2) Need for a urinary catheter	2) Zero patients
	3) Mental confusion	3) 7 patients
	4) Need venous hydration	4) Zero patients
	5) Condition at hospital discharge.	5) 74 patients

Statistical Analysis

For statistical analysis, the correlation matrix between variables in a dataset, Cramér's V association between two categorical variables, the Kruskal-Wallis's test to analyze datasets containing both qualitative and quantitative variables were used. The significant value was 5%.

Results

Seventy-four centenarians underwent surgery and anesthetized between 2010 and 2019 for femur fractures, 86.4% of whom were female (Figure 1). The age provided was confirmed with the supporting document. Demographic data of patients are shown in Table 2. The youngest being 100 years old and the oldest being 112 years old. All patients were anesthetized with regional anesthesia, with a combination of spinal anesthesia and lumbar plexus block. There were no problems related to anesthetic management. The major pre-existing illnesses in the 74 centenarians' patients were result of arteriosclerotic, cardiac diseases and diabetes, 5.5% being ASA I, 81% ASA II and 13.5% ASA III. Of the 74 patients, only 1 (112 years) were referred to the ICU. All 74 centenarian patients entered the project directly and none were suspended from their surgical procedure. The average length of hospital stay before the procedure was 6 ± 4 days, with the earliest being 1 day and the longest being 24 days, due to material problems. The mean fasting time was 2:42 ± 0:45 hours, with the shortest time being 35 minutes and the longest fasting time of 4:00 hours. Correlation matrix between variables in a dataset status (Figure 2). The mean surgery time was 1:28 ± 0:30 hours and the mean duration of anesthesia was 2:33 ± 0:44 hours. Oral CHO administration in the PACU was on average 1:42 ± 0:48 hours and the stay in the PACU was on average 2:04 ± 0:42 hours. And the reintroduction of oral food in the ward was on average 6:08 ± 1:01 hours.

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Figure 1: Several centenarians and their anesthetized ages.

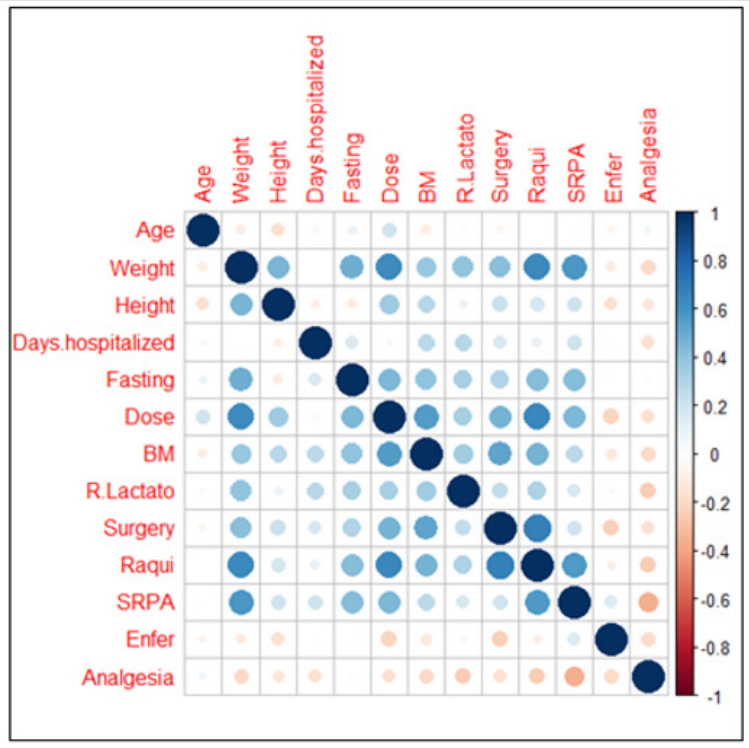

Figure 2: Correlation matrix between variables in a dataset status.

Table 2: Demographic data.

Variables	Results
Age (year)	102.24 ± 2.32
Weight (kg)	58.82 ± 14.44
Height (cm)	154.41 ± 9.51
Gender: F/M	64 / 10
ASA: I / II / III	4 / 60 / 10

None of the 74 centenarian patients presented nausea and vomiting before, during or in the immediate postoperative period. All patients underwent spinal anesthesia in a sitting position and there was no need for supplementation with general anesthesia. The needles used were 25G Quincke 7 times, 26G Quincke in 25 times, 27G Quincke in 42 times, all without introducer. The average dose of 0.5% isobaric bupivacaine was 8.63 ± 2.03 mg, with the lowest dose being 6 mg and the highest dose being 15 mg (Figure 3). The cephalad dispersion varied between T12 and T6, in all patients. A very small p-value indicates that there is a statistically significant difference in the dose between cephalic dispersion of analgesia. Thus, the dose varies significantly across the different levels of analgesia (Figure 4). Fifty-nine patients (80%) had grade 3 motor block, and 15 (20%) patients had grade 2 motor block of the limbs. All patients received 500 mL of 6% hydroxyethyl starch in 0.9% sodium chloride and the average dose of lactated Ringer's was 1,188 ml. Arterial hypotension occurred in 3 (4%) patients and was easily treated with only one dose of ethilephryne. Bradycardia was not observed in any patient. Correlation matrix (Cramér's V) between variables (Figure 5) Patients' analgesia was performed with a lumbar plexus block. Before surgery, 54 neurostimulator blocks were performed inguinal and 20 after the end of surgery (7 inguinal and 13 psoas), with a mean duration of analgesia in the 74 centenarian patients was 22.02 ± 3.30 hours.

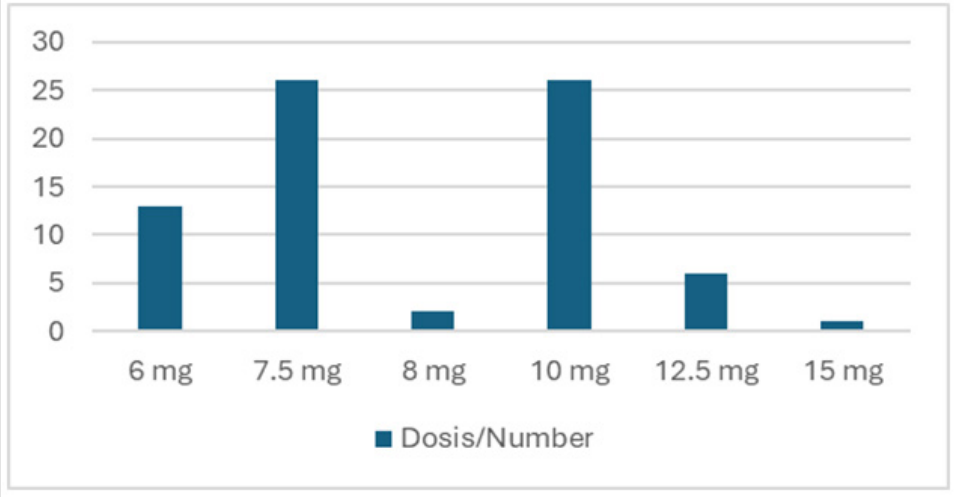

Figure 3: Dose of isobaric bupivacaine 0.5% used.

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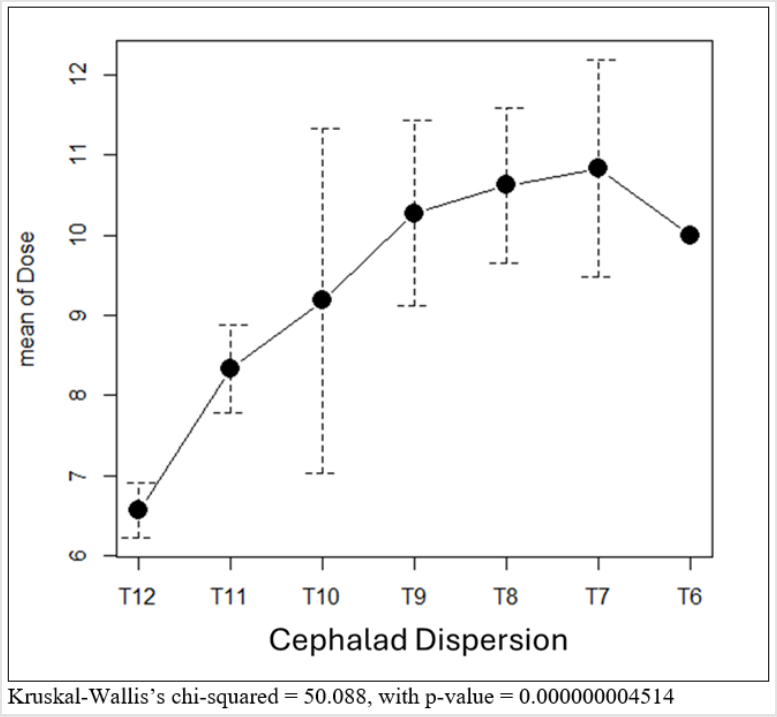

Figure 4: Relationship between dose and cephalic spread of analgesia.

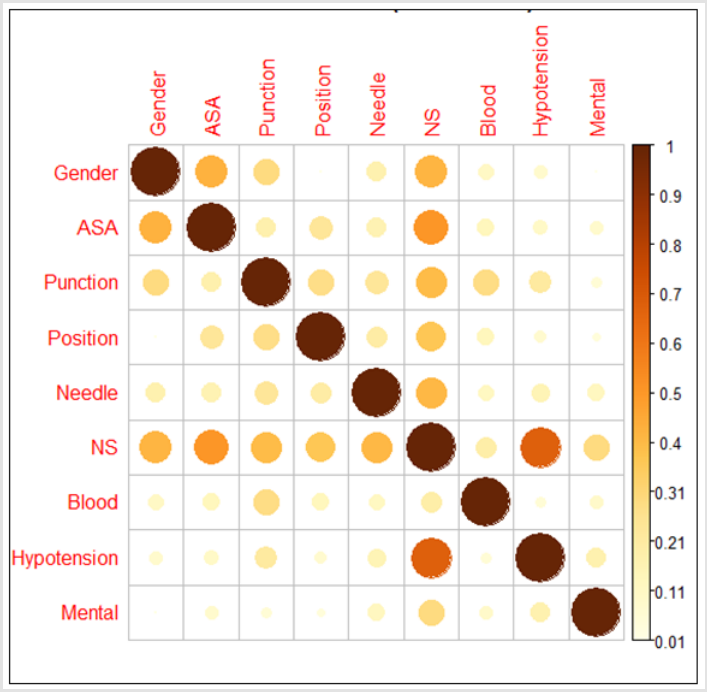

Figure 5: Correlation matrix (Cramér's V) between variables.

No patient required the use of a urinary catheter in the post-operative time, and no patient used a surgical drain as part of the conduct established with the implementation of the acceleration project. After discharge from PACU, the patient was transferred to the ward without intravenous hydration, none of the patients required hydration due to a drop in blood pressure and accepted oral feeding very well. All 73 patients transferred from PACU directly to the ward and were ready for hospital discharge on the first postoperative day. Only the 112-year-old patient was referred to the ICU as he was the 2nd oldest patient undergoing surgery and anesthesia in the world. Hospital discharge for residency dependent on the CHM Social Service. There was only one death at home in the first month after surgery.

Discussion

Hip fractures are one of the most frequent fractures presenting to the emergency department and orthopedic trauma teams. The terms hip fracture and neck of femur fracture are used synonymously. All 74 centenarians in this study reached extreme longevity in a relatively good health status, escaping or delaying fatal or strongly invalidating diseases, with an average age of 102 years with 86.5% female predominance, the oldest being 112 years old who underwent surgery and was discharged home, undergo regional anesthesia, surgery as early as possible with procedures to accelerate postoperative recovery. Studies between January 2000 to June 2022 for systematic review and meta-analysis included a total of 3,594 patients of 10 RCTs, submitted to regional anesthesia (RA) was associated with shorter duration of surgery, shorter length of hospital stays, and less intraoperative blood loss compared to general anesthesia (GA) [8]. There were no significant differences between the two groups in the number of blood transfusions, duration of anesthesia, 30-day mortality or postoperative delirium [8]. In this study with 74 centenarians, five patients required blood replacement due to bleeding, seven with mental confusion and only one death (1.3%) occurred in the first month after surgery at home. Spinal anesthesia is now commonly used for hip surgery in older adults. The effects of spinal anesthesia compared to GA on long--term outcomes have been studied, but the optimal anesthetic technique remains debated [9,10].

A large multicenter randomized trial found that mortality, ambulation, or other patient-centered outcomes at 1 year after surgery did not vary by anesthesia type [10]. As part of the implantation project, all patients were operated on under RA, associated with spinal anesthesia and lumbar plexus block for preventive analgesia (before surgery) or for postoperative pain control. In a recent study of 788 elderly Iranian patients with hip fracture, the 1-month mortality rate was 5.7% and the 1-year mortality rate was 20.2%, with the main risk factors being age ≥ 80 years, 48-hour delay in surgery, and preoperative ASA scores III and IV [11]. All patients were monitored at home until by phone, and the end of the first month after surgery, with only one death occurring during this period. No patient required completion of GA or intravenous sedation. A review of patients treated for hip fracture between January 2010 and August 2020 from a single institution was conducted in 1,032 patients, and the groups were divided into Blue Zone and non-Blue Zone [12]. Blue Zone patients had lower mortality at both 1 and 2 years postoperatively. The Blue Zone lifestyle affected the onset of frailty and delayed osteoporotic hip fracture for 12 years in this propensity-matched cohort study. In Brazil, no Blue Zone was identified, but it is important to state that over a period of 10 years, 74 patients underwent surgery and anesthesia for femur fractures under RA, without the need for a urinary catheter, and morphine, without the need for ICU and with abbreviation of fasting and reintroduction of food in the ward, and without complications.

A recent systematic review showed that the use of peripheral nerve blocks for analgesia on admission to hospital and for postoperative analgesia is essential for the outcome of elderly patients with femur fractures [13]. This approach was used with lumbar plexus blocks before or after surgery, lasting an average of 22 hours of analgesia. With the aim of verifying the association between nutritional status and handgrip strength in 100 elderly people (60-92 years old), it proved to be of great value for the early detection of malnutrition, frailty and sarcopenia in this group of patients [14]. Loss of lean mass can make older people more likely to suffer falls, fractures, disability, dependence, repeated hospitalizations, and increased mortality. In the 74 centenarians during hospitalization, no method was evaluated to verify the muscular fragility of these patients. Studying whether preoperative oral intake of 200 mL of a carbohydrate drink can improve comfort and satisfaction with anesthesia in 100 elderly patients with hip fracture, it was shown that it significantly reduces preoperative discomfort and satisfaction with anesthesia care [15]. In this group of 74 centenarians, a fasting time of 2.42 hours was obtained, with the use of CHO in the PACU for an average of 1:42 hours, and reintroduction of oral feeding in the ward for an average of 6:08 hours, increasing the safety and satisfaction of patients and their families. Blue Zone centenarians represent significantly high physical functioning and high levels of activity through labouring occupations, outdoor hobbies and in home activities [16].

The most predominant mode represented through the included studies was agricultural activities [16]. The key findings represent a significant effect on physical activity by environmental and cultural influences of each region [16]. This study with 74 centenarians showed that the predominant activities of this population was rural work in a semiarid area of intense heat. Based in Monteiro, in the Cariri region semiarid of Paraíba, "Zabé da Loca" turned 100 years in January 2024 [17]. After more than two decades living in the cave, she gained, in an agrarian reform process, a house in the settlement in the municipality of Monteiro. She worked hard as a farmer, with which she supported her family for many years, and her life was rocked by the sound of the pífano, a typical Northeastern musical instrument, whose echoed sound when blown sounds like that of other types of flutes. The typical food of the Cariri region of the northeast is rich in dishes with sun-dried meat, seafood and spices.

Conclusion

A Blue Zone is a region in the world where people are claimed to have exceptionally long lives beyond the age of 80 years due to a lifestyle combining physical activity, low stress, rich social interactions, a local whole-foods diet, and low disease incidence [18]. There are five recognized blue zones worldwide: Sardinia (Italy), Okinawa (Japan), Nicoya (Costa Rica), Ikaria (Greece), and Loma Linda (California). A 1999 study of elderly people living in Sardinia found a prevalence of 13 centenarians per 100,000 population, indicating unusual longevity, a total of 233 potentially eligible centenarians were traced in the entire territory [19]. There are 26 States of Brazil, and life expectancy was assessed in 2022, and the average life expectancy in Paraíba is 76.78 years, occupying 17th place, with men being 73.07 years (18th place) and women being 80.46 (16th place) [20]. In this study of 74 centenarians with femur fracture, underwent surgery under regional anesthesia (spinal and lumbar plexus), without the need for ICU admission, without the use of a urinary catheter, with reduced fasting time, with opioid-free analgesia lasting around 22 hours, and with only one death in the first month after surgery. This study showed that it is possible to perform procedures in centenarians safely and with patient satisfaction with a project to accelerate postoperative recovery in a SUS hospital in Paraíba. One question should conclude this study with 74 centenarians: could the semiarid northeast be a new Blue Zone, completely different from the 5 other Blue Zones described throughout the world, where agricultural activity is present throughout the lives?

Financial Support

No.

Conflict of Interest

No.

Contribution

No.

IRB

No.

Authors' Contribution

LEI: Study concept, data collection, performed all anesthesia, article writing, procedures, article review. DMPT, UL: Performed all surgeries, article review. TBV, SL, BB, MBLS, MD: Anesthesia was performed under the supervision of the main author, as a resident and anesthesiologist. GBMF: Conceived the research project, statistical analysis, final review of the article.

Key Points

Question: As one of the leading causes of elderly patients' hospitalization, femur and hip fractures, will present an increasing socioeconomic problem soon. Centenarian femur fracture patients can undergo surgery and anesthesia safely and successfully.

Findings: The 74 centenarians were anesthetized with regional anesthesia (spinal plus lumbar plexus block), without the use of morphine, urinary catheter and only one patient went to the ICU because he was 112 years old. There was only 1 death in the first month at home.

Meaning: The pre, intra and postoperative procedures used in the study provided better results, such as comfort and satisfaction of the patient and family with the anesthetic care used in this study, and conditions for hospital discharge on the 2nd postoperative day. Possible Blue Zone in the semi-arid region of Paraíba.

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