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Comparative Study between Continuous Spinal Anesthesia versus Epidural Anesthesia in Geriatric Patients Undergoing Major Hip Surgery

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Abstract

Background: Hip surgeries (Hip fracture and arthroplasty) are the second most common reason why older people are admitted to hospitals, & as the population's mean age rises, it is turning into a serious public health issue.

Aim of Study: The goal of this research is to compare continuous spinal anaesthesia versus epidural anaesthesia in geriatric studied cases undergoing major hip surgeries (hip fractures and hip replacement).

Patients and Methods: In Al-Azhar University Hospitals (Assuit), sixty studied cases older than sixty years old who were scheduled for major hip surgery & classified as class II or III by the American Society of Anesthesiologists participated in this randomized, double-blind comparative trial. Studied cases had been randomly assigned to 2 equal groups: Group I consisted of thirty studied cases who received continuous spinal anesthesia, & Group II consisted of 30 studied cases who received continuous epidural anesthesia.

Results: Both methods provide effective methods of anesthesia for elderly studied cases undergoing major hip surgeries, with no difference in the intraoperative and postoperative complications.

Conclusion: In conclusion, this comparative study demonstrates that both continuous spinal anesthesia & continuous epidural anesthesia have been effective methods for providing surgical analgesia in elderly studied cases undergoing major hip surgery, with similar performance times and durations of surgical analgesia.

Key Words: Spinal Anesthesia – Epidural Anesthesia – Geriatric – Hip Surgery.

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Introduction

HIP surgeries (Hip fracture and arthroplasty) are the 2nd most common reason why older people are admitted to hospitals, & as the population's mean age rises, it is turning into a serious public health issue **[1].**

Effective postoperative pain control & a decreased risk of cardiac & pulmonary complications are two benefits of epidural anesthesia. Additionally, because of its sympatholytic impacts, a lower incidence of postoperative ileus & venous embolism is documented in these studied cases. Relative hypotension, which lowers intraoperative blood loss & the need for blood transfusion, is another possible benefit **[2].**

Compared to spinal anesthesia, epidural anesthesia requires a larger pharmacological dosage of local anesthetics & is technically more sophisticated & less dependable **[3].**

Continuous spinal anesthesia was initially published in 1907 for use in anesthesia practices. Today, high-risk studied cases undergoing lower limb & lower abdomen surgery in Europe employ this approach to increase cardiovascular stability. With minimal hemodynamic alterations, CSA provides the right amount & duration of anesthesia while allowing for the titration of tiny dosages of local anesthetic **[4]**.

To lessen the challenges & problems of CSA with microcatheters, such as challenging catheter insertion, breakage, inadequate anaesthesia, post-dural puncture headache, & occasionally the onset of cauda equina syndrome, a novel catheter-over-needle design has been developed **[5].**

This research compared continuous spinal anesthesia with epidural anesthesia for elderly studied cases undergoing major hip procedures, such as hip replacements & fractures).

Primary outcome: Hemodynamic stability [mean arterial blood pressure (MAP)]. Secondary outcomes: Features of sensory block, motor block, onset time between both techniques and surgeon's & studied case's satisfaction.

Patients and Methods

After approval from the Medical Ethical Committee (No.65 on 12/9/2021) of the Faculty of Medicine, Al-Azhar University (Assiut) and after obtaining patient's Informed consent 60 studied cases of ASA physical status II & III of either genders aged above sixty years old scheduled for major hip surgery at Al-Azhar University Hospitals (Assiut) had been enrolled in this Comparative Double Blinded Randomized Study in the duration from September 2021 to August 2023. The study was registered in ClinicalTrials.gov ID: NCT06340256.

Study Groups: Computer-generated numbers were used to randomly divide sixty studied cases into 2 equal groups in parallel, & each studied case's allocation code was stored in an opaque, closed envelope. Group I (N=30): Continuous spinal anesthesia was used to put the studied cases to sleep. Group II (N=30): Continuous epidural anesthesia was used to sedate the studied cases. Sample size calculation: G. power 3.1.9.2 had been used to calculate the sample size (Universität Kiel, Germany). The following factors were taken into account when calculating the sample size: Eighty percent power & a 0.05 α error to show a ten percent drop in MAP (the main outcome) with CEA (mean 96.44 & SD 12.26 mmHg in CSA based on a prior research) **[6]**. Therefore, 30 patients were allocated in each group.

Exclusion criteria: Patients Refusal, Infection at the injection site, neurological diseases, spinal deformity, hypersensitivity to amide local anesthetics, neuropathy, Coagulopathy, ASA physical status less than II, more than III and emergency operation and age less than 60 years old.

Preoperative:

All studied cases were subjected to the followings: Past Events Exams, investigations, & the gathering of demographic data (age, gender, weight, height, & body mass index) involve the following: Complete blood count, random blood sugar, kidney & liver function tests, coagulation profile testing, ECG, & echocardiography.

As soon as the studied case entered the operating room, the Mindray ipm 8 monitor from Russia was used to begin monitoring the arterial saturation of oxygen (sao2), mean arterial blood pressure, noninvasive blood pressure, & electrocardiogram (ECG). Intraoperative: Every patient had an intravenous line (18G cannula). Airway & resuscitation equipment were easily accessible, all equipment for spinal or epidural blockade was prepared for use, Ringer had been started as a co-load, & all prescriptions had been filled before the studied case had been positioned For the lumbar puncture.The studied case should be positioned with their back parallel to the edge of the bed next to the anesthesiologist, their knees bent towards their abdomen, their neck flexed, & their midline palpated. Using a line drawn among the palpated iliac crests, the L4–L5 interspace or the body of L3–L4 was located. All procedures were carried out under 100% aseptic conditions using betadine ten percent. At the intended insertion site, a little wheal of three milliliters of local anesthetic (two percent lidocaine) was injected into the skin.

Anesthesia technique:

Group I Continuous Spinal Anaesthesia (CSA: A22-G catheter (Spinocath, B. Braun, Melsungen, Germany) was used over a27-G Quincke needle in group CSA. The catheter's priming volume was 0.1ml. The spinal needle-containing catheter progressed through the epidural space until dural puncturing had been felt & cerebrospinal fluid had been visible inside the catheter, following the recognition of the epidural space with a modified Touhy needle. After that, the catheter was introduced three cm cephalad into the subarachnoid space & fed over the needle into the intrathecal space. After removing the modified Tuohy needle & spinal needle, the catheter was fitted with a Luer connector & a filter that had been previously filled with the anesthetic solution (priming volume: 0.6ml). The drug of choice was simple bupivacaine 0.5 percent (MARKYRENE. 5% 20ml vial from Dawa Store – Egypt). The CSA group was administered one milliliter (five milligrams) of 0.5 percent plain bupivacaine along with twenty-five micrograms of fentanyl (fentanyl manufactured by Sunny Pharmaceutical Co., Egypt) via catheter injection at a rate of 0.2 milliliters per second.

Group II Continuous Epidural Anaesthesia (CEA): Peri fix 401 filter epidural set (B.Braun) had been used (Spinocath, B. Braun, Melsungen, Germany). It is made up of a 1.3 x 80mm Tuohy epidural needle (1 8G); a 0.85 x 0.45 x 1000mm (20G) epidural catheter with three lateral apertures; a 1ml loss-of-resistance syringe; a 0.2µm Perifix flat filter; & a Perifix screw connector. A 20G catheter is then placed 3cm cephalad into the epidural space after the needle progresses until the epidural space has been determined using the loss-of resistance technique. A test dose of 3 millilitres of two percent lidocaine (Lidocaine HCL Alexandria Co., Egypt) mixed with one percent adrenaline was injected via catheter.

After 3 minutes, 10ml of bupivacaine (0.5 percent) was administered into the catheter along with 50μg of fentanyl. Additional doses of 5ml of plain bupivacaine 0.5 percent had been injected epidurally every ten minutes until the level of T10 or a maximum of 25ml of plain bupivacaine 0.5 percent had been obtained if the sensory blockade did not reach T10 within twenty minutes of the administration of the initial dosage. If the sensory blockage fails to reach T10, anesthetic failure had been considered, & the studied cases had been substituted with new participants & removed from the trial. Five milliliters of 0.5 percent bupivacaine was given subcutaneously, causing the sensory level to recede by 2 segments. Following the procedure, the catheter had been taken out & its integrity examined.

Data collections: Patients characteristics of studied groups as regard (age, gender, weight, height, BMI, ASA physical status, duration of surgery & type of surgery). Characteristics of Anesthesia of studied groups as regard: Performance time of the procedure (minutes) from skin puncture by the local anesthetic syringe till the end of our procedure, onset time of sensory block, motor block, time to reach T10 sensory level, time to reach complete motor block, time to achieve maximum level of sensory block, duration of postoperative analgesia. Hemodynamic changes (HR, MAB) before the procedure (baseline) every five minutes after initial dose for fifteen minutes then every twenty minutes throughout the rest of operation. The total amount of bupivacaine administered as well as the quantity of top-up doses. Contentment among patients: Verbal rating score for satisfaction with analgesia throughout the procedure at the conclusion of the procedure (0 = excellent, 1 = good, 2 = fair, & 3 = poor) **[3]**. Surgeon satisfaction: The Surgeon Satisfaction with Anesthesia Services scale has 4 levels at the conclusion of the procedure: Strongly disagree, disagree, agree, and very agree) **[7]**. Incidence of intraoperative complications as regards hypotension, bradycardia, nausea, vomiting & pruiritis had been recorded. Six milligrams of ephedrine (Ephedrine sulphate 25mg/1ml Misr-co Egypt) was used to treat hypotension, which was defined as a twenty percent or greater drop in mean arterial blood pressure from baseline or systolic blood pressure of less than 90mmHg following spinal block. This treatment would have been repeated if there was no improvement in keeping the systolic blood pressure above 100mmHg. Atropine (0.5mg) was used to treat bradycardia, which had been specified as a drop-in heart rate of fewer than sixty beats per minute (Atropine 1mg/1ml CID co Egypt). Postoperative monitoring for hypotension, postoperative nausea & vomiting, & pruritis occurs every 10 minutes in the PACU & every thirty minutes following ward discharge for a period of six hours. Statistical analysis: IBM Inc., Chicago, IL, USA used SPSS v26 for statistical analysis. The normality of the data distribution had been assessed using histograms & the Shapiro-Wilks test. The mean & standard deviation of quantitative parametric variables had been reported, & the unpaired Student's ttest had been used to compare the 2 groups. The Mann Whitney test had been used to analyze quantitative non-parametric data, which were reported as the median & interquartile range. When appropriate, the Fisher's exact test or the Chi-square test had been used to analyze the frequency & percentage (%) of the qualitative variables. A *p*-value with 2 tails less than 0.05 was deemed statistically significant.

Results

Eighty-one studied cases had been evaluated for this research's eligibility; fourteen studied cases were found to not meet the requirements, & seven studied cases declined to take part. The remaining studied cases were divided into 2 equal groups at random, with thirty studied cases each).

Patient's characteristics had been insignificantly different among both groups (Table 1).

Table (1): Studied cases properties of the studied groups.

	Group I (n=30)	Group II (n=30)	*p*-value
Age (years):			
Mean ± SD	73.43±6.76	75.7±7.16	0.212
Sex:			
Male	13 (43.33%)	17 (56.67%)	0.302
Female	17 (56.67%)	13 (43.33%)	
ASA physical status:			
II	21 (70%)	23 (76.67%)	0.559
III	9 (30%)	7 (23.33%)	
Duration of surgery (min):			
Mean ± SD	183.5±22.29	187±21.88	0.542

BMI: Body mass index.
ASA: American Society of Anesthesiologists.
DHS: Dynamic hip screw.
THR: Total hip replacement.

Performance time & duration of postoperative analgesia were insignificantly different between both groups. Onset time (of motor and sensory block), time to reach sensory level T10, time to achieve complete motor block & time to achieve maximum sensory level were significantly lower in group I than group II (*p*-value <0.001) (Table 2).

Number of top-up doses and total doses of bupivacaine were significantly lower in group I than group II (*p*-value=0.022 & <0.001, respectively) (Table 3).

Intraoperative complications (hypotension, Nausea & vomiting, and pruritus) were insignificantly different among both groups.

Postoperative complications (hypotension, PONV, pruritus, low backache and headache) had been insignificantly different among both groups (Table 4). There are no reported cases in the study as regard infection and neurological complications.

Patient and surgeon satisfaction had been insignificantly different among both groups (Table 5).

Table (2): Features of anesthesia of the studied groups.

	Group I (n=30)	Group II (n=30)	*p*-value
Performance time (min):			
Mean ± SD	5.5±1.5	4.93±1.66	0.171
Onset time of motor block (min):			
Mean ± SD	4.34±1.63	9.32±4.73	<0.001*
Onset time of Sensory block (min):			
Mean ± SD	2.63±0.72	5.13±0.97	<0.001*
Time to reach sensory level T10 (min):			
Mean ± SD	9.37±2.97	17.53±7.82	<0.001*
Time to achieve complete motor block (min):			
Mean ± SD	10.57±4.05	21.43±6.22	<0.001*
Time to achieve maximum sensory level (min):			
Mean ± SD	17.07±4.31	25.87±6.95	<0.001*
Duration of post-operative analgesia (min):			
Mean ± SD	97.83±19.52	89.73±18.47	0.104

*: Significant as *p*-value ≤0.05.

Table (3): Number of top-up doses and total dose of bupivacaine of the studied groups.

	Group I (n=30)	Group II (n=30)	*p*-value
Number of top-up doses:			
Mean ± SD	1.77±0.86	2.27±0.78	0.022*
Total dose of bupivacaine (mg):			
Mean ± SD	11.42±2.68	92.83±11.31	<0.001*

*: Significant as *p*-value ≤0.05.

Table (4): Postoperative complications of the studied groups.

	Group I (n=30)	Group II (n=30)	*p*-value
Hypotension:			
Intra operative:			
Yes	3 (10%)	5 (16.67%)	0.640
No	27 (90%)	25 (83.33%)	
Postoperative:			
Yes	2 (6.67%)	4 (13.33%)	0.389
No	28 (93.33%)	26 (86.67%)	
Nausea & Vomiting:			
Intra operative:			
Yes	4 (13.33%)	5 (16.67%)	0.718
No	26 (86.67%)	25 (83.33%)	
Postoperative:			
Yes	4 (13.33%)	5 (16.67%)	0.718
No	26 (86.67%)	25 (83.33%)	
Pruritus:			
Intra operative:			
Yes	3 (10%)	2 (6.67%)	0.640
No	27 (90%)	28 (93.33%)	
Postoperative:			
Yes	4 (13.33%)	3 (10%)	0.688
No	26 (86.67%)	27 (90%)	
Low backache:			
Yes	3 (10%)	2 (6.67%)	0.640
No	27 (90%)	28 (93.33%)	
Headache:			
Yes	1 (3.33%)	2 (6.67%)	0.554
No	29 (96.67%)	28 (93.33%)	

Table (5): Patient and surgeon satisfaction of the studied groups.

	Group I (n=30)	Group II (n=30)	*p*-value
Patient satisfaction:			
Excellent	14 (46.67%)	9 (30%)	0.337
Good	9 (30%)	14 (46.67%)	
Fair	7 (23.33%)	7 (23.33)	
Surgeon satisfaction:			
Strongly disagree	2 (6.66%)	3 (10%)	0.309
Disagree	3 (10%)	5 (16.66%)	
Agree	13 (43.3%)	11 (36.66%)	
Strongly agree	12 (40%)	11 (36.66%)	

Discussion

The benefits of epidural anesthesia include effective postoperative pain management & a lower incidence of cardiac & pulmonary problems *[2]*. Our study aimed to assess hemodynamic changes [mean arterial blood pressure (MAP)]. Features of sensory block, motor block Onset time between both techniques. Surgeon's & studied case's satisfaction.

In our study, performance time and duration of surgical analgesia were insignificantly different between both groups. Onset time, time to reach sensory level T10, time to achieve complete motor block & time to achieve maximum sensory level were significantly lower in group I than group II (*p*-value <0.001). Like ours Reisli et al. *[8]* investigated the hemodynamic impacts of continuous epidural anesthesia with prilocaine against CSA in studied cases (TURP), noting that CSA demonstrated a quicker start & recovery of motor & sensory block. In contrast, Tummala et al. *[9]* who sought to evaluate the clinical outcomes of spinal anesthesia against combined spinal epidural anesthesia in elderly highrisk studied cases having hip replacement surgery. Both cohorts had good motor block, fast onset, & excellent analgesia. This difference in results may be attributed to variations in patient populations, surgical procedures, anesthesia techniques, methodology, publication bias, potential advances in medical practices, and random variability.

In high-risk elderly studied cases, when progressive sympathetic block onset is preferred to minimize hemodynamic side effects, the CSEA is especially helpful *[10]*.

In our study, number of top-up doses and total doses of bupivacaine were significantly lower in groupI than group II (*p*-value=0.022 & <0.001, respectively).

This agrees with Baydilek et al., *[11]* who evaluated the effectiveness of levobupivacaine-based CSA and SDSA in studied cases having TURP. The CSA group recovered more quickly after achieving the desired level of anesthesia with a lower anesthetic dose.

This is supported by Ebied et al., *[12]* who revealed that Wiley Spinal anesthesia showed less anesthetic dose as compared to continuous epidural anaesthesia. This result was consistent with Ebied et al., *[12]* who, in a comparison of continuous spinal anesthesia with continuous epidural anesthesia in elderly studied cases undergoing transurethral resection of the prostate, demonstrated that the total intraoperative bupivacaine dose had been significantly lower in the CSA group as compared to group CEA (11.7±2.4vs. 83.3±29.4mg; p<0.001). Moreover, Ahmad et al. *[13]* who aimed to compare the incidence of hypotension in continuous spinal anesthesia CSA versus single dose spinal anesthesia (SDA) in octogenarians undergoing hip surgery, the total use of Ephedrine & the incidence of spinal complications. The dose of bupivacaine had been significantly lower in CSA group compared to SDA group. In our research, mean arterial blood pressure measurements had been insignificantly different at baseline, five min, ten min, fifteen min, seventy-five min, ninety-five min, 115min, 135min and at the end among both groups and had been significantly higher at 35min & 55min in group I than group II (*p*-value=0.011 and 0.008 respectively).

In our study, heart rate measurements were insignificantly different at baseline, 5min, 10min, 75min, 95min, 115min, 135min and at the end between both groups and were significantly higher at 15min, 35min and 55min in groupI than group II (*p*-value <0.05).

This agreed with Baydilek et al., *[11]* who reported that CSA provided better hemodynamic stability compared to SDSA.

This result was consistent with Beh et al., *[4]* They concluded that, in older patients, small, titrated doses of CSA are a beneficial anesthetic approach that offer greater hemodynamic stability than single shot anesthesia & CEA. Ahmad et al., *[13]* reported that the MAP had been more maintained in the CSA group compared to the SDA group. Hypotension had been termed as a 20% reduction from the baseline reading to avoid severe hypotension and was measured noninvasively. The slower and less severe decline in hemodynamics in CSA group can be explained by the slower onset of segmental block, compared to SDA group where sympathetic block occurs abruptly, allowing easier cardiovascular adaptation.

Moreover, Abdelaziz et al., *[14]* reported that, starting point Similar HR existed in both groups. When comparing the CSE group to the CSAgroup, the CSEgroup's heart rate had been much greater at five & fifteen minutes. In comparison to the CSAgroup, the mean blood pressure had been considerably lower in the CSE group at five & fifteen minutes.

A retrospective study of 318 cases receiving CSA, noticed that an initial dose <1.5ml of bupivacaine 0.5 percent (7.5mg) provided stable hemodynamics and that patients who received an initial volume higher than 1.5ml were 2.78 times more likely to develop hypotension as compared to those who received a volume <1.5ml *[4]*.

In our study, complications (hypotension, PONY, pruritus, low backache and headache) were insignificantly different between both groups.

This outcome was consistent with Lux, *[15]* They determined that continuous spinal anesthesia seemed to be a suitable & safe anesthetic approach

for elderly studied cases undergoing lower leg surgery.

Furthermore, it was consistent with Imbelloni et al., *[16]* It was discovered that CSA offered favorable surgical conditions with a low rate of problems. seventeen individuals under mixed spinal epidural anesthesia & four individuals under continuous spinal anesthesia were reported to have hypotension.

A frequent adverse reaction to CSA is a high rate of postdural puncture headaches *[17]*. It was proposed to use smaller needles & microcatheters to lessen this side effect since the microcatheter's temporary sealing of the dural hole can lower the chance of a postoperative pneumothorax (PDPH), particularly when the spinal catheter has been removed twenty-four hours after surgery *[18]*.

Radke & Radke, *[19]* demonstrated that the rate of PDPH can be lowered by inserting the stylet into the spinal needle before the cerebral spinal fluid is drawn out of the space.

There had been no difference in the incidence of (PDPH) among the twenty eightgauge microcatheter and the twenty two-gauge Quincke or Sprotte needle used for dura puncture in a retrospective investigation *[20]*.

This outcome was consistent with Amin & Fathy, *[21]* In research including forty adult studied cases scheduled for lower abdominal procedures, it was shown that 87.5 percent of studied cases reported good satisfaction & ninety-five percent of surgeons strongly agreed with CSA.

Conclusion:

In conclusion, this comparative study demonstrates that both continuous spinal anesthesia & continuous epidural anesthesia have been effective methods for providing surgical analgesia in elderly studied cases undergoing major hip surgery, with similar performance times and durations of surgical analgesia. However, continuous spinal anesthesia exhibited advantages such as faster onset, quicker attainment of sensory & motor blocks, & reduced medication requirements, resulting in more stability in blood pressure & heart rate during specific time intervals. Importantly, both techniques demonstrated comparable safety profiles and levels of patient and surgeon satisfaction.

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دراسة مقارنة بين التخدير الشوكى المستمر والتخدير فوق الجافية لدى المرضى المسنين الذين يخضعون لجراحة الورك الكبرى

الخلفية: تعد جراحات الورك (كسر الورك وتقويم المفاصل) ثانى أكثر الأسباب شيوعًا لدخول كبار السن إلى المستشفيات، ومع ارتفاع متوسط عمر السكان، فإنها تتحول إلى مشكلة صحية عامة خطيرة.

الهدف: الهدف من هذا البحث هو مقارنة التخدير النخاعى المستمر مع التخدير فوق الجافية فى حالات الشيخوخة التى تمت دراستها والتى تخضع لعمليات جراحية كبرى فى الورك (كسور الورك واستبدال مفصل الورك).

طرق البحث: فى مستشفيات جامعة الأزهر (أسيوط)، تم دراسة ستين حالة أكبر من ستين عامًا من المقرر أن تخضع لجراحة الورك الكبرى والمصنفة على أنها من الدرجة الثانية أو الثالثة من قبل الجمعية الأمريكية لأطباء التخدير، وقد شاركوا فى هذه التجربة المقارنة العشوائية مزدوجة التعمية. تم تقسيم الحالات المدروسة عشوائياً إلى مجموعتين متساويتين: المجموعة الأولى تتكون من ثلاثين حالة مدروسة تلقت تخديراً شوكى مستمرا، والمجموعة الثانية تتكون من ٣٠ حالة مدروسة تلقت تخدير فوق الجافية مستمر.

النتائج: كلا الطريقتين توفران طرق تخدير فعالة لحالات كبار السن الذين خضعوا لعمليات جراحية كبرى فى الورك، مع عدم وجود اختلاف فى المضاعفات أثناء العملية وبعدها.

الاستنتاج: فى الختام، توضح هذه الدراسة المقارنة أن كلا من التخدير النخاعى المستمر والتخدير فوق الجافية المستمر كانا من الأساليب الفعالة لتوفير التسكين الجراحى فى الحالات المدروسة لكبار السن والتى تخضع لجراحة الورك الكبرى، مع أوقات أداء وفترات مماثلة للتسكين الجراحى.