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Evaluation of the Efficacy of Fentanyl versus Dexamethasone as an Adjuvant to Isobaric Bupivacaine in Ultrasound Guided Supraclavicular Brachial Plexus Block

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ABSTRACT

Background: Changed adjuvants have been used to extend regional blockage, shorten onset times of blocks and prolong time of post-operative analgesia.

Objectives: This study aimed to compare the effect of dexamethasone plus bupivacaine versus fentanyl plus bupivacaine in ultrasound guided supra-clavicular approach of the brachial plexus block for upper limb surgeries.

Subjects &Methods: A prospective randomized double-blind research that was conducted in the South Valley University Hospital, Qena, Egypt. The study included 90 patients of both sexes, scheduled for upper limb surgeries (Orthopedic and plastic surgeries). **Result:** Regarding onset of sensory block (min) it was minor in fentanyl category followed by dexamethasone category & longer in control category with important differences. Complete sensory block (min) occurred in shorter period in fentanyl group then in dexamethasone group and took longer period to occur in control group with significant difference. Time of sensory block (hr) was longer among dexamethasone group followed by fentanyl group and less period in control with significant difference. **Conclusion:** The addition of dexamethasone or fentanyl to bupivacaine in supraclavicular brachial plexus block was safe in terms of hemodynamic stability and side effects, and significantly prolongs time of sensory & motor block & reduces VAS scores.

Keywords: Dexamethasone, Fentanyl, Isobaric bupivacaine, Ultrasound.

INTRODUCTION

After many surgeries, inadequate postoperative pain management remains major issue. Optimal postoperative pain management necessitates thorough understanding of pain pathophysiology, surgical procedure invasiveness, & studied case factors related to increased pain, such as anxiety & depression. Use of multimodal perioperative pain management provided rational basis for better postoperative pain control, fewer adverse impacts, & higher studied case satisfaction **(1)**.

Different adjuvants were used to prolong regional blockage, shorten the onset times of blocks & prolong time of post-operative analgesia. Adjuvants such as fentanyl, midazolam, magnesium sulphate, dexamethasone, & neostigmine were added to local anaesthetics in attempt to prolong block time & postoperative analgesia **(2)**.

Steroids cause vasoconstriction, acting similarly to epinephrine by reducing local anaesthetic absorption. Another theory is that dexamethasone can act locally on nociceptive C-fibers to raise activity of inhibitory potassium channels, thus reducing their activity **(3)**. We hypothesized that peri-neural dexamethasone added to bupivacaine vsfentanyl added to bupivacaine and their combination together in ultrasound-guided supraclavicular brachial plexus block would prolong time of sensory analgesia & delay necessity for postoperative analgesia.

This research aimed for comparing impact of dexamethasone plus bupivacaine versus fentanyl plus bupivacaine in ultrasound guided supra-clavicular approach of brachial plexus block for upper limb surgeries.

PATIENTS & METHODS

This prospective randomized double-blind research was done in South Valley University Hospital through the period from April 2021 to June 2022.Ninety patients according to American Society of Anesthesiologist Grade 1 & 2 were studied of both genders with age ranged from 20 to 60 years. They were undergoing numerous bony orthopedic or plastic surgeries on upper limb under supraclavicular brachial plexus block. The study included three categories of thirty studied cases each. Studied cases have beenhaphazardly allocated into 3 groups: Group A**:** Bupivacaine 0.25% + dexamethasone 0.1mg/Kg, group B received bupivacaine 0.25% + fentanyl 1µg/kg and group C received bupivacaine 0.25% + normal saline 0.9%.

Inclusion criteria:

Patients recruited for elective upper limb orthopedics or plastic surgeries according toAmerican Society of Anaesthesiologist class 1 & 2 & aged from 20 to 60 years of both sexes.

Exclusion criteria: American Society of Anesthesiologists3- 4 status patients, morbid obesity (BMI > 40), severe & systemic bacterial infection, allergy to amide local anesthetic & morphine sulphate, studied case with seizure disorder, studied case with history of atrial & ventricular arrhythmia, studied case with history of autonomic dysfunction, studied case with history of renal dysfunction, liver dysfunction, congestive heart failure.

Trial drugs: Dexamethasone (Dexamethasone-MUP) [R] 8mg/2ml ampoule; MUP Egypt), **Fentanyl**

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(Fentanyl-hameln)^{R}(0.1mg/2ml); HamelnPharma GmbH – Germany).

Methodology:

Following approval from South Valley University Hospital ethical committee, 90 studied cases undergoing elective upper limb surgery, such as arm, forearm, & hand fractures.All collected data were confidential and used for the purpose of scientific research only.All studied cases were divided into 3 groups randomly. 2nd blinded researcher recorded studied cases' assessments & observations in both operating room & recovery room. The groups of studied cases were assigned randomly: **Group A** (Dexamethasone Group): received injection of bupivacaine (0.5%) 20 mL plus dexamethasone 2ml (8 mg)[total 22mlvolume],**group B** (Fentanyl group): received injection of bupivacaine (0.5%) 20 mL plus fentanyl 2mL (100µg)**[** total 22ml volume] and**group C (**Control group) received injection of bupivacaine (0.5%) 20 mL plus saline 0.9% 2ml.**[** total 22 ml volume.

2 experienced anesthesiologist evaluated studied cases intra- & post-operatively. Both were unaware of cured groups. Ultrasound electronics HS-2100 was used to accomplish neural localization. Portable ultrasound machine with six-thirteen MHz linear probe. After needle penetrated brachial plexus cluster, local anesthetic combined with dexamethasone **(Group A)** received injection of bupivacaine (0.5%) 20mL plus dexamethasone 2ml(8mg), **group B** received injection of bupivacaine (0. 5%) 20mL plus fentanyl 2mL (0.1mg) and **group C** received injection of bupivacaine (0. 5%) 20mL plus normal saline 0.9% 2mL by injection. After negative aspiration for blood or air close to artery, combination was injected incrementally, and needle was repositioned to inject on upper pole of artery. Ultrasound detected local anesthetic dispersion at time of injection.

Intra-operative parameters contained sensory evaluation, motor block, & problems. Pinprick exam was used every minute in dermatomal areas corresponding to median, radial, ulnar, &musculocutaneous nerves after complete drug injection until full sensory blockade was achieved. Sensory onset was considered when studied cases felt dull to pinprick sensation along dermatomal areas of any of previously mentioned nerves. Complete sensory was regarded when there was complete loss of sensation to pinprick. Sensory block was graded as follows: grade zero for sharp pin sensation, grade one for analgesia & dull sensation, & grade two for no sensation. Period of sensory block was described as time among complete sensory block & first postoperative pain & was documented. Same observer measured motor block at each minute until complete motor blockade after drug injection.

Intraoperative tracking of vital parameters such as heart rate (HR), mean blood pressure (MAP), & oxygen saturation (SPO_2) was performed after block, after skin incision, & every five minutes for 1st hour, then every fifteen minutes until surgery was completed. Mean of all measurements were taken during observation time was calculated& compared among 3 groups.

Postoperative evaluation contained: Analgesia which has been evaluated at one, 6, 12 & 18hours postoperatively using visual analogue scale.

Data collection: Demographic characteristics (Age, gender and BMI), Clinical data **[**Hemodynamic data (baseline- after block-after skin incision and every 15min during surgery) include heart rate, mean arterial blood pressure, arterial oxygen saturation, onset & period of sensory block, onset & period of motor block, surgery period, and postoperative pain measured using visual analogue pain scale.

Intraoperative & postoperative adverse impacts: Hypotension, bradycardia, nausea, vomiting and itching.

Ethical Approval:

South Valley University Ethics Board approved this research, each participant signed informed written consent form. This work was done in accordance with World Medical Association's Code of Ethics (Declaration of Helsinki) for human research.

Statistical analysis

Data has been tabulated & analyzed by **SPSS** software version 26 &**Microsoft Excel 2016**. For quantitative variables, inferential analyses have been performed by independent t-examination in cases of 2 independent categories with parametric data & **Mann Whitney U**in cases of 2 independent categories with non-parametric data. For qualitative data, inferential analyses have been performed by **Chi square examination** for independent groups. **Wilcoxon Rank examination** was used to determine statistical significance of non-parametric variable variation among related samples. Level of significance has been set at **P value**≤ 0.05, which indicates that data is important; or else, it is not. P-value is statistical measure of likelihood that outcomes if research could have happened by chance.

RESULTS

Research was conducted on 90 adult studied cases admitted to Orthopedic or Plastic Surgery Department of South Valley University Hospitals. Studied cases were haphazardly classified into three groups: Group A (n=thirty) received dexamethasone, group B (n=thirty) received fentanyl &group C (n=thirty) obtained normal saline 0.9 percent. Table (1) showed that there were no significant differences between groups.

Table (1): Comparing among three tested groups according to demographic data

		Group A (n = thirty)		Group B (n = thirty)		Group C (n = thirty)		p
		No.	**%**	**No.**	**%**	**No.**	**%**	
Gender	Men	seventeen	56.7	16	53.3	18	60.0	0.665(NS)
	women	thirteen	43.3	14	46.7	12	40.0	
Age (years) Mean ± SD.		37.50 ± 6.60		37.80 ± 6.57		37.80 ± 6.56		0.979(NS)
BMI (kg/m^2) Mean ± SD.		28.60 ± 1.13		28.80 ± 1.19		29.0 ± 1.51		0.487(NS)
ASA	1	21	70.0	18	60.0	24	80.0	0.240(NS)
	2	9	30.0	12	40.0	6	20.0	

(NS) no statistically important variation P value >0.05 *****P value≤ .05 is important, P value<0.01 is greatly important, SD: Standard deviation, ^{Z}MWU = Mann- Whitney U examination X^2= Chi- Square examination

Group A: Dexamethasone Group **Group B:** Fentanyl Group **Group C:** Control Group

Table1 shows that there was insignificant differences between three groups as regard demographic data and ASA

Table (2): Sensory block & motor block between studied groups

	Group A (n = thirty)	Group B (n = thirty)	Group C (n = thirty)	P
Duration of surgery (min)	92.20 ± 4.38	92.50 ± 4.32	91.50 ± 5.19	0.695(NS)
Onset of sensory block (min)	7.31 ± 1.33	6.52 ± 1.0	8.03 ± 0.99	<0.001*
Onset of motor block (min)	6.17 ± 1.16	5.09 ± 1.16	8.07 ± 1.41	<0.001*
Duration of sensory block (hr)	8.89 ± 1.73	7.80 ± 2.48	6.30 ± 1.58	<0.001*
Duration of motor block (hr)	9.52 ± 1.55	8.01 ± 1.97	6.30 ± 1.58	<0.001*

(NS) no statically important variation P value ≥, 05 *****P value<.05 is important P value<.01 is greatly important SD: Standard deviation, ^{Z}MWU = Mann- Whitney U examination X^2= Chi- Square examination.

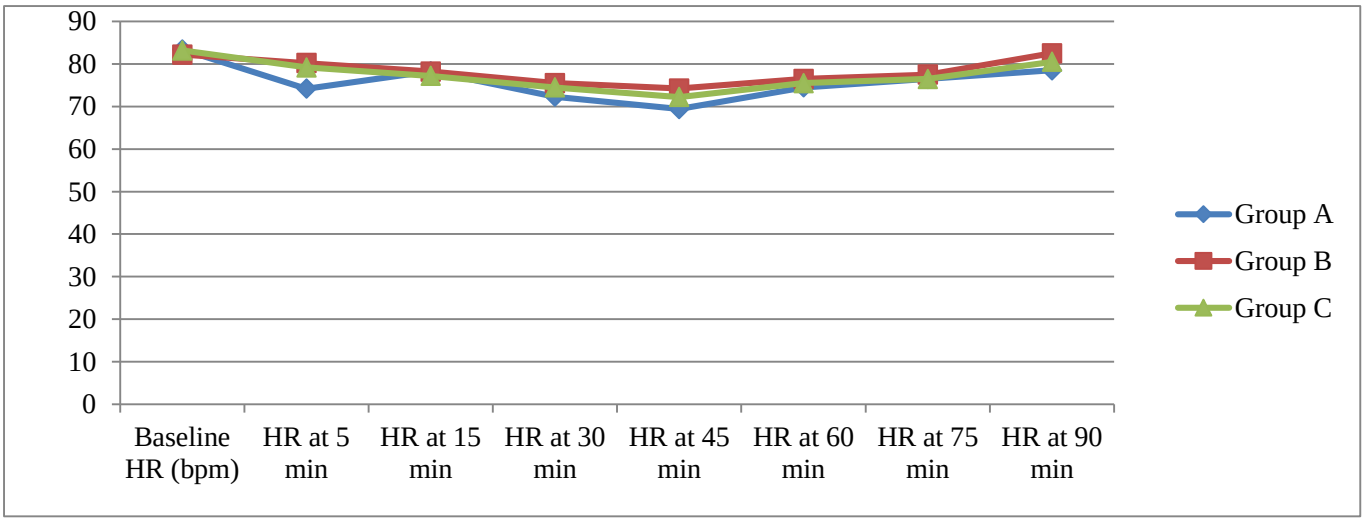

Fig (1): HR among the three studied groups

There was insignificant differences between three groups as regard duration of surgery but as regard onset of sensory and motor block there was significant increase in group C vs other groups but as regard duration of sensory and motor block there was significantly higher in group- A

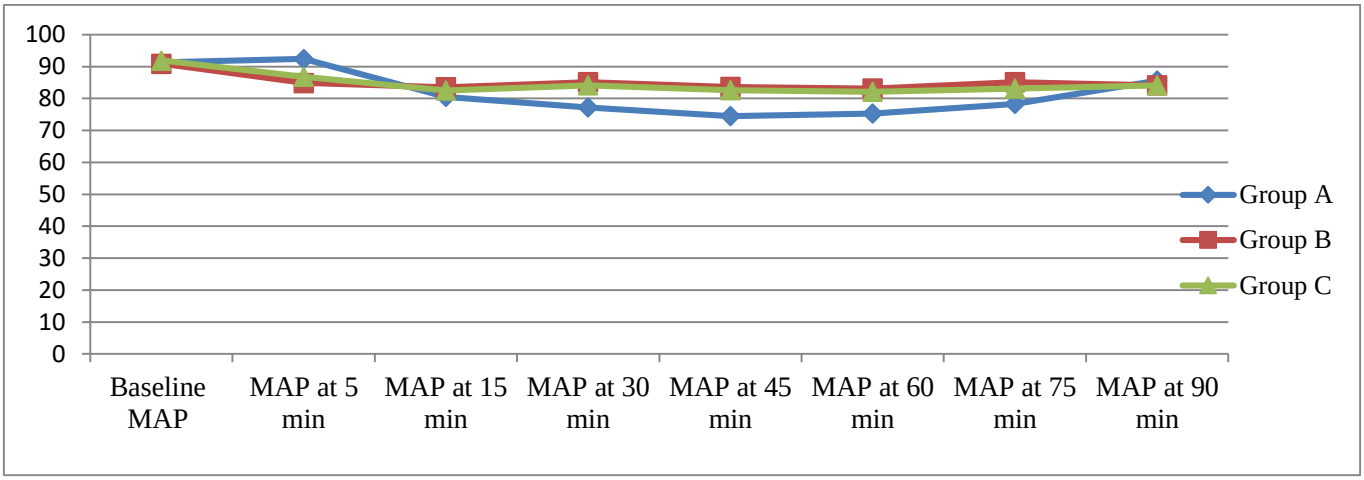

Fig (2): MAP among the three studied groups

Table (3): Postoperative VAS score (1, 6, 12 and 18h)

Hour	Group A (n = thirty)	Group B (n = thirty)	Group C (n = thirty)	P-value
Hour one	0.2 ± 0.2	0.3 ±0.1	0.4 ±0.3	0.661
Hour 6	1.5 ±0.3	3.4 ±0.7	5.1 ±0.3	**0.004***
Hour 12	3.9 ±0.3	4.7 ±0.4	5.4 ±0.4	**0.002***
Hour18	4.35 ±0.5	4.9 ±0.62	5.6 ±0.2	**0.001***

(NS) no statically significant difference Pvalue≥ , 05 ***P** value<.05 is important, P value<.01 is greatly important SD: Standard deviation ^{Z}MWU = Mann- Whitney U examination

As regard VAS post operation there was insignificant differences after 1 hour between three groups but after 6 , 12 , 18 hours there was significant lower VAS level in group A in comparison to other groups

Table (4): Duration to first analgesic request (min) &Rescue analgesia (mg) between studied groups

		Group (A) (n = thirty)	Group (B) (n = thirty)	Group (C) (n = thirty)	P-value
Time to first analgesic request (min)	**Mean± SD**	9.59 ± 2.32	8.45 ± 2.52	7.00±0.79	**0.0001***
Rescue analgesia (mg)	**Mean± SD**	75± 42.56	100.5 ± 44.7	160.3 ± 28.6	**0.0003***

(NS) no statically significant difference Pvalue ≥ 0,05 ***P** value< 0.05 is important P value< 0.01 is greatly important SD: Standard deviation ^{Z}MWU = Mann- Whitney U examination

As regarding time to first analgesic there was significant longer duration in group A vs other groups also regarding rescue of analgesia were significantly lower in group A than other groups

Table (5): Comparing among three tested groups according to postoperative problems

Postoperative complications	Group A (n = thirty)		Group B (n = thirty)		Group C (n = thirty)		P-value
	No.	%	No.	%	No.	%	
No	30	100.0	28	93.3	30	100.0	
Nausea and vomiting	0	0.0	1	3.3	0	0.0	0.12
Itching	0	0.0	1	3.3	0	0.0	

(NS) no statically significant difference Pvalue≥ , 05***P** value<.05 is important
P value<.01 is greatly important SD: Standard deviation ^{Z}MWU = Mann- Whitney U examination

There was insignificant differences between three groups as regard postioperative complications

DISCUSSION

Adding of 1mcg/Kg fentanyl to bupivacaine for ultrasound-guided supraclavicular brachial plexus block had led to shortening of onset of sensory & motor block, whereas adding of .1mg/Kg dexamethasone to bupivacaine for ultrasound-guided supraclavicular brachial plexus block had led to prolongation of time of motor & sensory block& increase time of postoperative analgesia when they were compared with control group (normal saline0.9%).

Onset of sensory block & time of complete sensory block (min) parameters in our study showed that it was lower in fentanyl group than in dexamethasone group& significantly longer in control group. In agreement with our outcomes, **Badawy*et al*.**[4] who studied 60 cases scheduled for upper limb surgeries, separated into 2 groups Group 1: (Fentanyl group): received 100 mcg Fentanyl + 20 ml bupivacaine 0.5%. Group two: (Dexamethasone group): received eight mg dexamethasone + 20 ml of bupivacaine 0.5%. They reported that onset of sensory block was quicker in fentanyl category compared to dexamethasone category. Period of complete sensory block was shorter in fentanyl category compared to dexamethasone category because of fentanyl opioid agonist effect. Our outcomes agree with **Hamed*et al*.**[5]who confirmed that onset of sensory block in fentanyl category needed shorter time than in control category. Lastly, **Rai*et al*.**[6] reported that dexamethasone category has significantly rapid onset of sensory block than control group.

Concerning time of sensory block (hours), results of our study showed that dexamethasone group had significantly longer duration than fentanyl group & followed by control group. In agreement with our outcomes **Badawy*et al*.**[4]reported that duration of sensory block was prolonged in dexamethasone category compared to fentanyl category, because of dexamethasone suppressive effect on inflammatory mediators and the capillary membrane become less permeable. Also **Hamed*et al*.**[5]described that period of sensory block in fentanyl category was significantly longer in comparison to control category. Lastly **Kaur*et al*.**[7] found that fentanyl group had prolonged period of sensory block in comparison with control category.

As regards onset of motor block (min), it was-lower in fentanyl category followed by dexamethasone group and longer in control group with significant differences. Complete motor block (min) occurred in lower period in fentanyl group then in dexamethasone group and was significantly of longer period control group. In agreement with our outcomes **Badawy*et al*.**[4] showed that onset of motor block were faster in fentanyl category compared to dexamethasone category and time of complete motor block was significantly shorter in fentanyl category compared to dexamethasone category. In addition, **Hamed*et al*.**[5] showed that onset of motor block was significantly lower in fentanyl category than in control category. Also, the **Kaur*et al*.**[7]found that fentanyl group has rapid onset of motor block than control group. Moreover, **Rai*et al*.**[6] reported that dexamethasone group has faster onset of motor block than control group. Additionally, Hamed*et al*.**[5]reported that time of motor block in fentanyl category has been longer in comparison with control category. Also, **Kaur*et al*.**[7]showed that fentanyl category has prolonged time of motor block in comparison with controls. Furthermore, **Rai*et al*.**[6] reported that dexamethasone group has prolonged time of motor block in comparison with control category. However, the study by **Yaghoubi*et al*.**[8]reported that there was no important variation among dexamethasone category &fentanyl category.

Comparing among 3 tested categories regarding period of 1st analgesia rescue showed that there was significant longer duration in dexamethasone category than in fentanyl category and shorter period to take analgesia in control group. This is in agreement with **Badawy*et al*.**[4]who showed that time of analgesia was longer in dexamethasone category than in fentanyl category. Also, **Kaur*et al*.**[7]showed that time of analgesia has been minimum in saline group as compared to dexmedetomidine and fentanyl groups which was statistically significant.

Regarding evaluation of postoperative pain score (VAS score), which showed that pain score showed significant differences between three groups where it was lower in dexamethasone group than in fentanyl group and higher in control because of the strong analgesic opioid effect of fentanyl. In agreement with our outcomes **Yaghoubi*et al*.**[8]reported that the VAS scores in groups of dexamethasone and fentanyl were significantly lower than control category with no significant variation among dexamethasone & fentanyl groups. Also, **Badran*et al*.**[9]reported that the VAS readings have been lower in dexamethasone category than in control category.

In the study in our hands, we found that total postoperative analgesic (diclofenac sodium 75mg) consumption was lower in dexamethasone category than in fentanyl category & greater in control category. In agreement with our findings, **Baral*et al*.**[10]indicated that total consumption of analgesia has been less in the first 24 hours in dexamethasone category. Also, **Badran*et al*.**[9]showed that greater ketolac consumption has been observed in control category than in dexamethasone category. Similarly, **Tandoc*et al*.**[11] reported that postoperative analgesic consumption for 1st forty eight hours has been minor in dexamethasone categories compared to control category.

In the present study, we found that postoperative complications mainly in form of itching or nausea and vomiting were found in fentanyl group without any variations among the 3 categories.While,**Badawy*et al*.**[4] reported no any complications.Furthermore, **Baral*et al*.**[10] reported that Exception of nausea & vomiting, which have been greater in control category when compared to dexamethasone category,

there was no variation among 2 groups in terms of postoperative problems.

CONCLUSION

In supraclavicular brachial plexus block, addition of dexamethasone or fentanyl to bupivacaine was safe in terms of hemodynamic stability & side effects, & it prolonged period of sensory & motor block & decreased VAS scores.

DECLARATIONS

- **Consent for Publication:** I verify that all authors have agreed to submit manuscript.
- **Availability of data & material:** Available
- **Competing interests:** None
- **Funding:** No fund
- **Conflicts of Interest:** authors confirmed that they had no conflicts of interest regarding publication of this paper.

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