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EFFECT OF DEXMEDETOMIDINE AND FENTANYL AS ADJUVANT TO ROPIVACAINE IN POPLITEAL FOSSA NERVE BLOCK FOR POST OPERATIVE ANALGESIA IN FOOT AND ANKLE SURGERIES

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Abstract

Background: Inadequately controlled pain negatively affects quality of life, function and functional recovery. It also increases the risk of post-surgical complications and persistent postsurgical pain**. Aim:** To observe the effect of Dexmedetomidine and Fentanyl as adjuvants to USG guided Popliteal nerve block with 0.2% Ropivacaine for post-operative analgesia in Foot and ankle surgeries. **Methods:** This prospective observational study was conducted at Bone and Joint Hospital which is one of the associated hospitals of Government Medical College, Srinagar over a period of 18 months, after obtaining approval from Institutional Ethical Committee and informed consent of the patients scheduled to undergo foot and ankle surgeries. A total sample size of 77 patients was available for the study, with 27 patients receiving Popliteal fossa nerve block (PFNB) with Inj.Ropivacaine 0.2% (24ml)+Normal saline (1 ml) designated as **GROUP SR**, 24 patients receiving Popliteal fossa nerve block (PFNB) with Inj. Ropivacaine 0.2% (24 ml)+ Inj. Dexmedetomidine (1ml-100µg) designated as **GROUP DR** and 26 patients receiving Popliteal fossa nerve block (PFNB) with Inj. Ropivacaine 0.2% (24ml) + Inj. Fentanyl (1ml-50µ) designated as **GROUP FR**. After receiving USG guided PFNB, the patients were observed for duration of analgesia, quality of analgesia, total dose of rescue analgesia consumed in 24 hours postoperatively and side effects of drugs. Pain was assessed using Visual Analogue Scale (VAS) of 0 to 10 with (0= no pain) and (10= worst imaginable pain). **Results:** Duration of analgesia was statistically significant among the three groups with longest duration in Group FR (7.8± 1.18 hours) followed by Group DR (5.6±1.67 hours) and was least in Group SR (4.1± 1.66 hours) (p value< 0.05).Postoperative pain scores were found to be lowest in group FR, as compared to those in group DR and group SR, with the patients in group SR having the highest pain scores. Total quantity of rescue analgesia consumed within 24 hours postoperatively were maximum in group SR followed by group DR and was least in group FR (p value<0.005). There were no major side effects observed in patients among all three groups. 3.7% of patients in Group SR and 3.8% of patients in Group FR had nausea (single episode). 3.8% patients in Group FR had vomiting (single episode). Bradycardia (mild) was noted in 8.3% in Group DR. 4.2% patients had mild hypotension in Group DR while as 3.8% patients had mild hypotension in Group FR. The side effects were mild

in all three groups and were statistically insignificant (p value >0.05). **Conclusion:** We concluded that the addition of fentanyl and dexmedetomidine to ropivacaine for Popliteal fossa nerve block in foot and ankle surgeries prolongs duration of block, increases postoperative analgesia time and reduces total amount of rescue analgesic consumed postoperatively. Both the adjuvants were safe to use.

Keywords: Foot and ankle surgeries, Postoperative analgesia, Ultrasonography, peripheral nerve block, ropivacaine.

Introduction:

Poor postoperative management of pain can cause negative clinical outcomes that include deep vein thrombosis, pulmonary embolism, pneumonia, poor wound healing, insomnia and demoralization. [1,2] Prevention and treatment of pain may improve clinical outcomes, save health care resources, avoid clinical complications and improve quality of life.[3]

Foot and ankle surgeries are associated with severe pain which is significantly extended upto 48 hours and large amounts analgesics are required. [4,5] Inadequately controlled pain negatively affects quality of life, function and functional recovery. It also increases the risk of post-surgical complications and persistent postsurgical pain.[6] Therefore effective postoperative pain control is essential for faster postoperative recovery and better patient satisfaction.

Postoperative pain relief can be achieved by a variety of techniques including parenteral non-steroidal anti-inflammatory drugs,[7] central and peripheral nerve blocks [8,9] and intravenous analgesia with opioids. However, most of them carry risk of complications and need for monitoring. The side effects of these pain relief modalities can be avoided by using peripheral nerve blocks for post operative analgesia. [10,11] Properly conducted peripheral nerve blocks avoid hemodynamic instability and pulmonary complications, facilitate post-operative pain relief and timely discharge from the hospital. Peripheral nerve blocks are suitable substitutes for parenteral analgesics for postoperative analgesia in lower limb surgeries because of the peripheral location of the surgical site and the potential to block pain pathways at multiple levels.[12]

With the use of long acting anesthetics the maximum duration of effective analgesia after a single injection is only 8-24 hours. [13] Interventions that increase the duration of local anesthetics action could prolong postoperative patient comfort[27]. [14] Therefore local anesthetics in combination with adjuvants are often used in an attempt to prolong the duration of single-shot Popliteal fossa nerve block. [15,16] Dexmedetomidine and Fentanyl are two such adjuvant drugs that have been used in combination with Ropivacaine to enhance the analgesic efficacy of the drugs and to facilitate early achievement and prolongation of block. [17]

Material & methods:

The study was conducted in the Bone and Joint Surgery Hospital, an associated hospital of Government Medical College, Srinagar. After obtaining approval of the Institutional Ethical Committee and informed consent of the patients for participation in the study, patients scheduled to undergo foot and ankle surgeries were enrolled in this prospective observational study from November 2019 to April 2021.

Inclusion Criteria

1. Patients scheduled for ankle and foot surgeries.
2. Age between 18-65 years.
3. American College Of Anesthesiologist (ASA)-Grade I, II.

Exclusion Criteria

1. Patient’s refusal.
2. Comorbidities-Cardiac disease, Renal/Hepatic dysfunction.

3. Patient with known contraindication to any of the drugs used.
4. Surgery that would cause pain outside the distribution of Popliteal nerve.
5. Neuropathy in the surgical extremity.
6. Patient with contraindication to regional anesthesia (coagulopathy,local infection).

A detailed history, thorough physical examination and relevant laboratory investigations were conducted in all selected patients. One day prior to surgery day, the visual analogue scale (VAS) scoring and details of the block procedure were explained to all patients.

All the included patients were categorized into three groups:

I. GROUP SR: Received Inj. Ropivacaine 0.2% 24ml + 1 ml of Normal saline

II. GROUP DR: Received Inj. Ropivacaine 0.2% 24 ml + 1ml Inj. Dexmedetomidine [100 mcg(Total Volume -25 ml)]

III. GROUP FR: Received Inj. Ropivacaine 0.2% 24 ml +1ml Inj. Fentanyl [50 mcg (Total Volume – 25 ml)]

PROCEDURE

After counseling and written informed consent, patient was taken to operating room where intravenous line was instituted and premedication with Inj. Pantoprazole 40mg i/v, Inj. Ondansetron 0.1 mg/kg i/v and Inj. Midazolam 1gm i/v was done. Monitors was attached and baseline parameters (heart rate[HR],blood pressure [BP],SpO_2 and electrocardiogram) were recorded. The Popliteal nerve block through lateral approach using Inj. Ropivacaine 0.2% (24ml) with normal saline (1ml) or Inj. Ropivacaine 0.2% (24ml)with fentanyl(50 µg) or Inj. Ropivacaine 0.2% (24ml)with dexmedetomidine(100µg) was given by an experienced Anesthesiologist using ultrasound guided technique. Sensory block evaluation was done using Pin prick method. Continuous monitoring of vitals done during and after the administration of the block.

After giving the popliteal fossa nerve block, patients were given Subarachnoid block with Inj. Bupivacaine 0.5% (Heavy) using 26 G spinal needle, which allowed the use of a thigh tourniquet during the surgery. After confirming the level of block, the patients were handed over to surgical team. Intravenous antibiotic were given before tourniquet insufflation. Standard anesthesia monitoring including non-invasive blood pressure, heart rate, three lead electrocardiograms were done. All patients were given supplemental oxygen @ 4 litres/min. After surgery, tourniquet was deflated. Total tourniquet tied time was recorded. After completion of the surgery, patients were shifted to the recovery ward and observed.

Pain was assessed at the end of the surgery (0 hour) and 2,4,6,8,12,18 and 24 hours after surgery. Post operative pain was assessed by using a 10-point Visual analog scale (VAS) in which a score scale of "0" was indicate "no pain" and a score scale of "10" "worst pain imaginable". A VAS score scale of more than $\geq$4 was taken as end point for duration of block and the patient was given rescue analgesics. First level of rescue analgesic was 1 gram of intravenous paracetamol, second level was 50 mg of intravenous Tramadol and third level was 75 mg of Diclofenac intravenously. The patients were observed postoperatively for 24 hours. Any side effects/complications were noted. The above data was subjected to statistical analysis.

PRIMARY END POINT: Time from performance of popliteal nerve block to the first rescue analgesia (measured by Visual analogue scale of pain-rating of $\geq$4).

SECONDARY END POINTS: total rescue analgesic dose, incidence of side effects.

Statistical Methods:

The recorded data was compiled and entered in a spreadsheet (Microsoft Excel) and then exported to data editor of SPSS Version 20.0 (SPSS Inc., Chicago, Illinois, USA). Statistical software SPSS (version 20.0) and Microsoft Excel were used to carry out the statistical analysis of data. Continuous variables were expressed as Mean±SD and categorical variables were summarized as percentages.

Analysis of variance (ANOVA) was employed for inter group analysis of data and for multiple comparisons, least significant difference (LSD) test was applied. Chi-square test or Fisher's exact test, whichever appropriate, was used for comparison of categorical variables. Graphically the data was presented by bar and line diagrams. A P-value of less than 0.05 was considered statistically significant. All P-values were two tailed.

Results:

There was no difference in demographic profile of the patients among the three groups in terms of age, weight, gender distribution, ASA status and duration of surgery [Table 1].

Table 1: Demographic profile of the study population

Parameters	Group SR (n=27)	Group DR (24)	Group FR (26)	P value
Age(years)	45.6±14.13	45.4±15.03	46.2±12.97	0.981
Weight(kg)	63.4±4.02	65.1±3.93	63.2±3.51	0.159
Gender(M/F)	15/12	18/12	21/09	0.854
ASA status I/II	23/4	21/3	22/4	0.954
Duration of surgery	78.1±18.25	76.9±16.47	76.9±13.57	0.949

The preoperative vitals which include heart rate, systolic blood pressure, diastolic blood pressure, mean arterial pressure, SpO2 were comparable among the three groups. There was no statistically significant difference among the three groups as far as preoperative vitals (p value >0.05) [Table 2].

Table 2: Preoperative vitals in patients of three groups

Parameters	Group SR	Group DR	Group FR	P value
HR	91.07±8.70	92.83±6.88	89.58±9.54	0.483
SBP	125.7±11.57	124.0±10.28	124.5±10.23	0.851
DBP	78.48±7.58	76.67±5.76	78.23±6.98	0.601
MAP	94.21±8.35	92.44±6.59	93.67±7.29	0.691
Spo_2	97.81±1.39	97.78±1.19	97.87±1.45	0.998

The difference in intraoperative vitals (heart rate, systolic blood pressure, diastolic blood pressure mean arterial pressure and SpO_2) between the three groups was statistically insignificant(p-value>0.05) [Table 3].

Table 3: Intraoperative vitals among the study population

Parameters	Group SR	Group DR	Group FR	P value
HR	82.31±8.66	83.21±8.65	79.16±9.49	0.193
SBP	116.76±11.69	116.82±10.17	117.42±9.63	0.853
DBP	70.24±7.73	69.06±5.83	70.61±6.50	0.617
MAP	85.75±8.23	84.97±6.40	86.21±6.80	0.691
Spo_2	98.83±1.36	98.91±1.26	98.81±1.19	0.925

Median VAS score of group FR was statistically lower than median VAS score of group DR and median VAS score of group DR was statistically lower than group SR. The VAS score at 0hr, 2hr, 4hr, 6hr, 10hr and 18hr was statistically significant and the VAS score at 8hr, 12hr and 24hr was comparable [Table 4].

Table 4: Comparison of VAS scores among the three groups

Time interval	Group SR	Group DR	Group FR	P value
0 Hour	1.37±0.63	0.83±0.70	0.08±0.27	<0.001*
2 Hour	2.56±1.55	1.67±1.67	0.54±0.51	<0.001*
4 Hour	3.54±1.49	2.42±1.36	0.85±0.88	<0.001*
6 Hour	2.41±1.44	3.38±1.47	2.08±1.29	0.005*
8 Hour	2.67±1.98	2.33±1.46	2.84±1.66	0.192

10 Hour	3.57±1.72	2.25±1.65	1.04±1.48	0.002*
12 Hour	2.63±1.62	2.21±1.53	1.81±1.44	0.157
18 Hour	2.85±1.81	1.65±1.82	1.58±1.74	0.019*
24 Hour	0.93±0.78	0.88±0.61	0.73±0.53	0.536

The mean duration of analgesia in patients of Group SR was 4.1±1.66 hours. The mean duration of analgesia in patients of Group DR was 5.6±1.67 hours. However, the mean duration of analgesia in patients of Group FR was 7.8±1.18 hours. The duration of analgesia in all the groups was statistically significant [Fig 1].

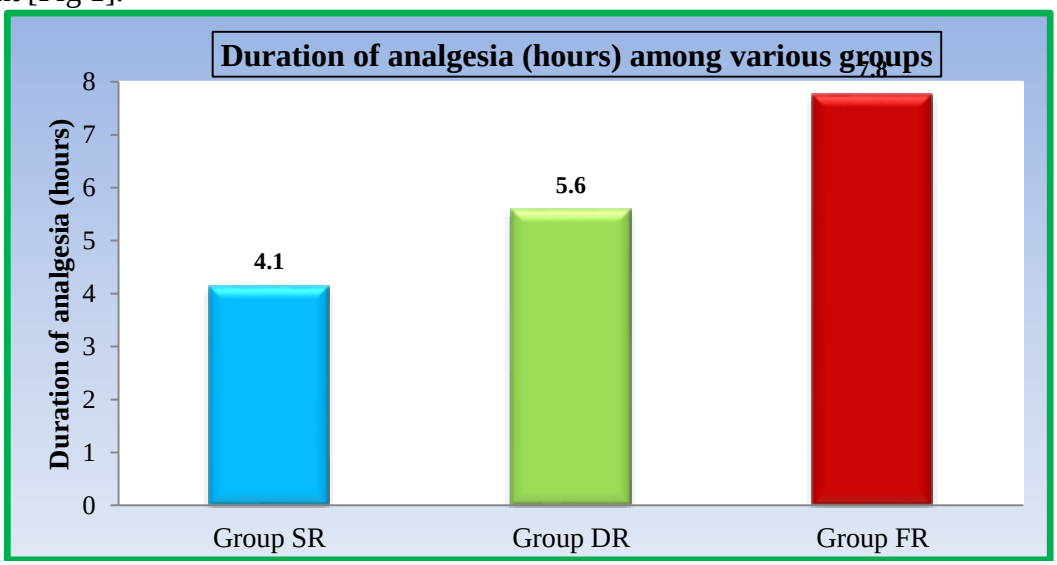

Fig 1.

The patients requiring Tramadol in Group SR was 100%, Group DR was 75% and in Group FR was 46.2%. The difference in percentage of patients requiring Tramadol was statistically significant with a p-value of <0.001. The patients requiring diclofenac in Group SR was 70.4%, Group SR was 8.3%and in Group FR was 0%. The difference in percentage of patients requiring tramadol was statistically significant with two other group having p-value of <0. 001. The difference in percentage of patients requiring Diclofenac was statistically significant with two other group having p-value of <0. 001. The patients requiring PCM in all the groups was100% [Fig 2].

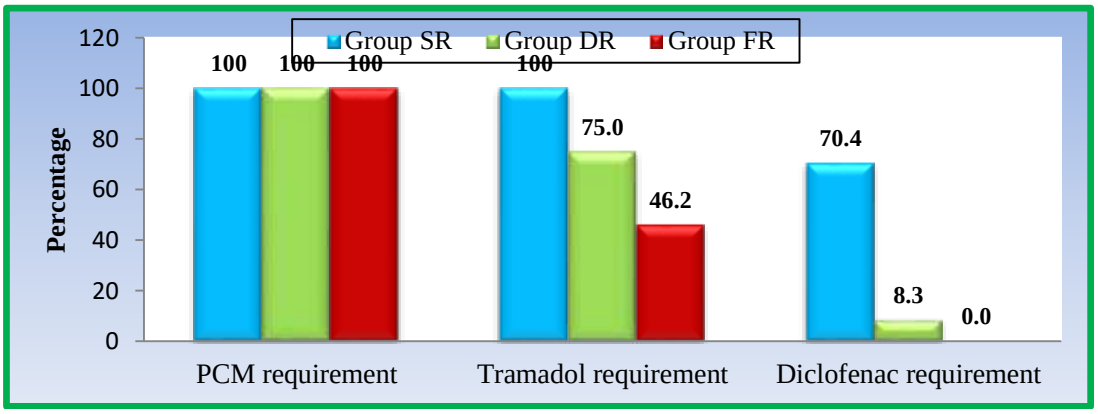

Fig 2.

The difference in side effects between three groups was statistically insignificant with a p-value of >0.001. 3.7% of patients in Group SR and 3.8% in Group FR had nausea.3.8% patients in Group FR had vomiting. Bradycardia was noted in 8.3% in Group DR. 4.2% patients had hypotension in Group

DR while as 3.8% patients had hypotension in Group C. The results were statistically insignificant (p value >0.05) [Fig 3].

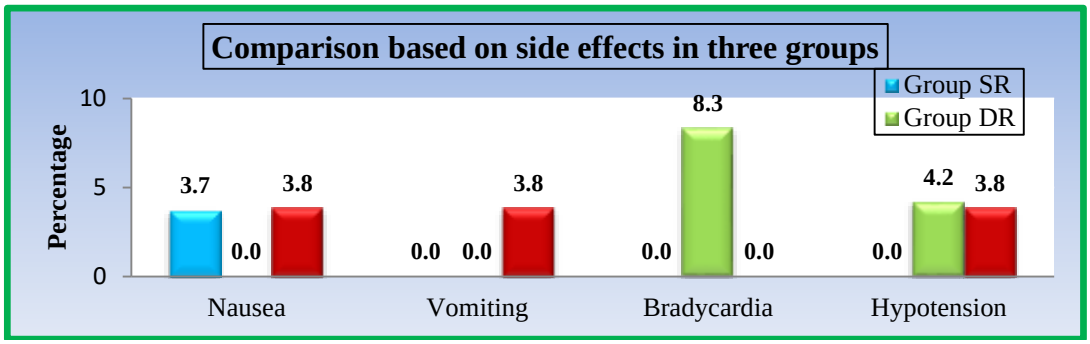

Fig 3.

Discussion:

Effective pain control after surgery remains a clinically significant concern as it has a large effect on the recovery process and patient satisfaction with postoperative care.[18]Foot and ankle surgeries induce moderate to severe pain acutely and often causes prolonged postoperative pain which may require large doses of parenteral opioids. [19] But opioids are associated with many side effects. Regional anesthesia with peripheral nerve blocks has become a mainstay in postoperative analgesia. In our study we have used local anesthetic ropivacaine (0.2%, 24ml).It is less lipophilic than bupivacaine and so is less likely to penetrate large myelinated motor fibres. [21] Hence theoretically it has lesser motor blockade, therefore it is hypothesised that it will facilitate early ambulation after surgery. In our study we have also used adjuvants dexmedetomidine and fentanyl along with inj. ropivacaine and observed their effect on the duration of analgesia and total duration of analgesia.

In our study the mean intraoperative heart rate was 82.31±8.66beats per minute in group SR, 83.21±8.65beats per minute in group DR and 79.16±9.49beats per minute in group FR. Comparing the mean intraoperative heart rate in all the groups, the difference was statistically insignificant (p-value of 0.193).The mean intraoperative systolic blood pressure was 116.76±11.69 mmHg in group SR, 116.82±10.17 mmHg in group DR and 117.42±9.63 mmHg in group FR. The mean intraoperative systolic blood pressure was comparable in all the groups and found statistically insignificant (p-value of 0.853).The mean intraoperative diastolic blood pressure was 70.24±7.37 mmHg in group SR, 69.06±5.83mmHg in group DR and 70.61±6.50mmHg in group FR. The comparison was statistically insignificant between the groups (p-value of 0.617).The mean intraoperative mean arterial blood pressure was 85.75±8.23mmHg in group SR, 84.97±6.40mmHg in group DR and 86.21±6.80 mmHg in group with a p-value of 0.765(statistically insignificant).The mean intraoperative oxygen saturation (SpO_2) was 98.83±1.36% in group SR, 98.91±1.26% in group DR and 98.81±1.19% in group FR. Comparing the mean intraoperative spO_2 inall the groups, it was found to be statistically insignificant (p-value of 0.925).

Sahi P et al (2018) in their study **"**Comparative evaluation of the effects of fentanyl and dexmedetomidine as adjuvants in supraclavicular brachial plexus block achieved with ropivacaine" also found that heart rate, blood pressure and spo2 were comparable in all the three groups, on addition of dexmedetomidine 1mcg/kg and fentanyl 1mcg/kg as adjuvants to ropivacaine.[21]These findings are in accordance to our study.

Hassan S et al(2018) in their study **"**Efficacy and safety of fentanyl as an adjuvant with bupivacaine and lignocaine in supraclavicular brachial plexus" also found statistically insignificant differences in hemodynamic parameters among the groups.[22]These findings are in consistence with those of our study where we observed that the difference in the hemodynamic parameters of patients in three groups receiving ropivacaine with or without adjuvants in popliteal fossa nerve block was statistically insignificant.

The mean duration of postoperative analgesia in our study was 4.1±1.66 hours in Group SR (Ropivacaine alone group), 5.6±1.67 hours in Group DR (Ropivacaine + Dexmedetomidine) and 7.8±1.18 hours in Group FR (Ropivacaine + Fentanyl). The difference in duration of analgesia among three groups was found to be highly statistically significant. Duration of analgesia was longer in Group DR than in Group SR and was statistically significant ($p<0.005$ SR vs DR) and duration was also longer in Group FR than in Group SR ($p<0.001$ SR vs FR). So there was statistically significant difference in analgesia among adjuvant groups as compared to plain ropivacaine. Among adjuvant groups, the duration of analgesia in Group FR was longer than in Group DR ($p<0.001$ DR vs FR) and the difference was statistically significant.

Aboelala MA et al (2018), conducted a double blinded RCT study "Dexmedetomidine in a surgically inserted catheter for transversus abdominis plane block in donor hepatectomy" in which they used 0.35mcg/kg dexmedetomidine as an adjuvant to bupivacaine and found prolonged postoperative analgesia in the group in which dexmedetomidine was used as an adjuvant. [23] In our study also we found that the duration of analgesia was significantly more in patients receiving dexmedetomidine with ropivacaine than the patients receiving ropivacaine alone.

Our results are also in accordance with that of **Farooq N et al(2017)**who conducted a study in which they compared dexmedetomidine (1mcg/kg) and fentanyl (1mcg/kg) as adjuvants to ropiovacaine in brachial plexus block. In their study they also found that fentanyl was a better adjuvant as compared to dexmedetomidine for prolongation of duration of analgesia. [17] Our study also shows that adding fentanyl to ropivacaine increases the duration of analgesia significantly.

Our study is also in accordance with that of **Kaniyil S et al (2016)**,titled "Does fentanyl prolong the analgesia of local anaesthetics in brachial plexus block?"They used fentanyl as an adjuvant to local anesthetic and found that it significantly prolonged the duration of analgesia. [24]

In a randomized comparative study by **Rajkhowa et al (2016)**"Fentanyl as an adjuvant for brachial plexus block". They concluded that fentanyl when used as an adjuvant to ropivacaine resulted in prolonged duration of analgesia. [25] Again this is in accordance to our study.

Hassan S et al(2018)in their study titled "Efficacy and safety of fentanyl as an adjuvant with bupivacaine and lignocaine in supraclavicular brachial plexus block" also concluded that when fentanyl was used as an adjuvant to local anesthetic resulted in prolongation of duration of analgesia.[22]

Taher-Baneh B et al(2019)studied effects of fentanyl and dexmedetomidine as adjuvant to bupivacaine. [26] They also concluded that fentanyl is more effective than dexmedetomidine which is in accordance with our results.

In our study, the visual analogue scale (VAS) score was lowest in patients who received fentanyl as adjuvant to ropivacaine as compared to patients who received dexmedetomidine as adjuvant and was highest in patients who received plain ropivacaine only. The difference in visual analogue scale (VAS) score between the three groups was statistically significant (p value <0.001).

Difference in analgesic consumption in 24 hours was statistically significant between Group SR, Group DR and Group DR (P value < 0.001). Analgesic consumption was maximum in Group SR, lower in Group DR and least in Group FR.

Farooq N et al(2017) in their study also found that lesser analgesia was consumed in group containing 1mcg/kg fentanyl as compared to 1mcg/kg dexmedetomidine as an adjuvant.[17]

In our study, majority of patients in the three study groups showed no major side effects to either drug or to block technique. Nausea (single episode) was experienced by 3.7% of patients in Group SR, 3.8% of patients in Group FR, while no patient in the DR group experienced nausea which was statistically insignificant(p- value 0.628). Vomiting (single episode) was seen in 1 patient (3.8%) in group FR ,which was managed with inj. Ondansetron @0.1 mg/kg while no patient in DR and FR groups experienced any episode of vomiting (Statistically insignificant-value 0.371). 4.2% patients had hypotension in Group DR, 3.8% patients had hypotension in Group FR ,which was resolved with 100 ml of fluid bolus, while no patient in Group SR had hypotension which was statistically insignificant(p- value 0.573). Bradycardia was noted in 2 patients (8.3%) in Group DR which reverted

spontaneously without any requirement of anticholinergic drugs while no patient in Groups SR and FR had bradycardia, which was statistically insignificant(p-value 0.104). Similar results were observed by

Sahi P et al (2018) in a study "Comparative evaluation of the effects of fentanyl and dexmedetomidine as adjuvants in supraclavicular brachial plexus block achieved with ropivacaine". They observed statistically insignificant adverse effects like nausea, vomiting, sedation, bradycardia and hypotension in the post- operative period in their study.[23]

Our study also correlates with that of ***Sun Q et al (2019)***[96] **"**Dexmedetomidine as an Adjuvant to Local Anesthetics in Transversus Abdominis Plane Block: A Systematic Review and Meta-analysis."They observed that addition of dexmedetomidine did not affect the incidence of postoperative nausea, vomiting, hypotension and bradycardia.[27]

CONCLUSION

In our study we concluded that the addition of fentanyl and dexmedetomidine to ropivacaine for Popliteal fossa nerve block in foot and ankle surgeries prolongs duration of block, increases postoperative analgesia time and reduces total amount of rescue analgesic consumed postoperatively. Both the adjuvants were safe to use. This study also showed that addition of fentanyl to ropivacaine showed significantly longer duration of postoperative analgesia in comparison to dexmedetomidine, without causing any significant side effects.

Conflict of interest: Nil
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References:

1. Carr DB, Goudas LC. Acute pain. Lancet 1999;353:2051–8.
2. Breivik H. Postoperative pain management: why is it difficult toshow that it improves outcome? Eur J Anaesthesiol 1998;15:748–51.
3. Apfelbaum JL, Chen C, Mehta SS, Gan TJ. Postoperative pain experience: Results from a national survey suggest postoperative pain continues to be undermanaged. AnesthAnalg. 2003;97:534-40.
4. Ong CK, Lirk P, Seymour RA, Jenkins BJ. The efficacy of preemptive analgesia acute postoperative pain management: a meta-analysis.Anaes Analog. 2005; 100(3):757-73.
5. Needoff M, Radford P, Costigan P. Local anaesthesia for post op pain relief after foot surgery: a prospective clinical trial. Foot Ankle Int.1995; 16(1):11-13.
6. Kehlet H, Jensen T, Woolf C. Persistent postsurgical pain:risk factors and prevention. Lancet 2006;367:1618-25.
7. Gurkan Y, Kilickan L, Buluc L, Muezzinoglu S, Tker K. Effects of diclofenac and inta-articular morphine/bupivacaine on post-arthroscopic pain control. Minerva Anesth.1999;65:741-5
8. Allen HW, Liu SS, Ware PD, Nairn CS, Owens BD. Peripheral nerve blocks improve analgesia after total knee replacement surgery. Aanesth Analog.1998;87:93-97.
9. Davies AF, Segar EP, Murdoch J, Wright DE, Wilson IH. Epidural infusion or combined femoral and sciatic nerve blocks as perioperative analgesia for knee arthroplasty. Br Anesth. 2004; 93: 368-74.
10. TharwatAI. Combined posterior lumbar plexus- sciatic nerve block versus combined femoral-obturator-sciatic nerve block for ACL reconstruction. Local and regional Anaesthesia.2011;41-46.
11. RungeC, BjØrnS, JensenJM, NeilsenND, VaseM, HolmC, BendtsenTF. The analgesic effect of a popliteal plexus blockade after total knee arthroplasty: a feasibility study. ActaAnaesthesiologicaScandinavica. 2018;62:1127-1132.
12. Chung F, Mezei G. What are the factors causing prolonged stay after ambulatory anesthesia? Anesthesiology 1998;89:A3.

13. CappelleriG,AldegheriG,RuggieriF,MamoD,FanelliG,CasatiA.Minimum effective anaesthetic concentration(MEAC) for sciatic nerve block:subgluteus and popliteal approaches.Can J Anaesth. 2007; 54(4):283.
14. Neal JM,GerancherJC,HeblJR,et al. Upper extremity regional anaesthesia:essentials of our current understanding.RegionalAnaesthesia and Pain Medicine2009; 34:134-70.
15. Cummings KC 3rd,Napierkowski DE,Parra-Sanchez I,etal.Effect of Dexamethasone on the duration of interscalene nerve blockswithropivacaine or bupivacaine.Br J Anaesth.2011;107(3):446-53.
16. PaqueronX,NarchiP,MazoitJX,SingelynF,BenichouA,Macaire P. Arandomised,observer-blinded determination of the median effective volume of local anaesthetic required to anaesthetize the sciatic nerve in the popliteal fossa for stimulating and non-stimulating perineuralcatheters.RegAnaesth Pain Med.2009; 34(4):290-95.
17. Farooq N,SinghRB,SarkarA,RasheedMA,ChoubeyS et al. To evaluate the efficacy of Fentanyl and Dexmedetomidine as adjuvant to Ropivacaine in Brachial plexus block:A double-blind,prospective,randomizedstudy.Anesth Essays Res 2017; 11: 730-39.
18. White PF,Issioui T, Skrivanek GD, Early JS, Wakefield C.The use of a continuous popliteal sciatic nerve block after surgery involving the foot and ankle:does it improve the quality of recover?Anesth Analog.2003;97(5):1303-9.
19. ProvenzoDA,ViscusiER,Adams SB Jr,KernerMB,Torjman MC, AbidiNA.Safety and Efficacy of the Popliteal Fossa Nerve Block when utilized for foot and ankle surgery.Foot Ankle Int.2002;23(5):394-9.
20. Kuthiala G, Chaudhary G. Ropivacaine: A review of its pharmacology and clinical use. Indian J Anaesth 2011;55:104-10.
21. Sahi P, Kumar R, Sethi C, Gupta N, Singh A, Saxena P. Comparativeevaluation of the effects of fentanyl and dexmedetomidine as anadjuvants in supraclavicular brachial plexus block achieved withropivacaine. International Journal of Contemporary Medical Research 2018;5(2):B25-B29.
22. Hasan S, Chowdhury AAN, Khatoon SN, Rashid MH, TipuMRH,Billah KMB et al. Efficacy and safety of fentanyl as an adjuvantwith bupivacaine and lignocaine in supraclavicular brachial plexusblock. ChattagramMaa-O-Shishu Hospital Medical College Journal2018; 17(2): 31-35.
23. Aboelela MA, Kandeel AR, Elsayed U, Elmorshedi M, ElsarrafW,Elsayed E, et al. Dexmedetomidine in a surgically inserted catheterfortransversus abdominis plane block in donor hepatectomy: Aprospective randomized controlled study. Saudi J Anaesth. 2018;12(2): 297-303.
24. Kaniyil S and Radhakrishnan P. Does fentanyl prolong theanalgesia of local anaesthetics in brachial plexus block? Arandomized controlled study. Int J Res Med Sci.2017;5(2):583-87.
25. Rajkhowa T, Das N, Parua S. Fentanyl as an adjuvant for brachialplexus block: A randomized comparative study. Int J Clin Trials2016; 3: 64-67.
26. Taher-Baneh N, Ghadamie N, Sahraie FSR, Nasseri K. BrazilianJournal of Anesthesiology (English Edition), Volume 69, Issue 4,July–August 2019, Pages 369-376.
27. Sun Q, Liu S, Wu H, Ma H, Liu W, Fang M et al. Dexmedetomidineas an Adjuvant to Local Anesthetics in TransversusAbdominisPlane Block: A Systematic Review and Meta-analysis. Clin J Pain.2019;35(4):375-84.