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RESEARCH ARTICLE

PERINEURAL DEXAMETHASONE AS ADJUVANT TO LOCAL ANAESTHETIC AGENT IN ULTRASOUND GUIDED POPLITEAL NERVE BLOCK FOR VARIOUS ANKLE & FOOT SURGERIES

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Abstract

Background: Ankle& foot surgeries are very common surgeries in various age groups like young & geriatric as well as in patients with comorbidities.popliteal nerve block is one of multimodal Anaesthesia & analgesia for same.we have used ultrasound guided block to prevent complications &precise volume at asite for improving Charisteristics of block.

Aims of study: To study the technique of giving popliteal nerve blocks with ultrasonographic guidance and evaluate it in terms of: No of attempts ,Time required for sensory and motor blockade,Quality of Intra operative analgesia ,Duration for post operative analgesia , Supplementation required in form of general anaesthesia & Complications encountered.

Methods: We have given ultrasonography guided popliteal nerve block in 100 adult patients of **ASA grade I/II/III** undergoing foot and ankle surgeries. The **volume of drug** used was **20ml** consisting of Lignocaine(1.5%) 10ml and Bupivacaine(0.5%) 10ml+ 2 ml Normal saline in Group A& addition of dexamethasone 8 mg as adjuvant to LA in Group B.

Results: The **mean time taken** to conduct the block was 4.3±1.4 mins in Group A,4.2±1.6 min inGr.B.The mean time taken for **sensory onset** was 3.8±1.1 mins in Gr A,3.6±1.4min in Gr.B .The mean time taken for **motor onset** was 7.2± 1.4 mins in GrA,7.0± 1.5 mins in Gr B.The mean time taken for **completing the surgery** was 39.2±5.0 mins in GrA,38.2±5.2 mins in Gr.B.The mean time taken **for complete motor regression** was 143.8±13.5 mins in Gr A,340.8±10.5 mins in Gr B.The mean time taken for **complete sensory regression** was 184.8± 16.8 minsin Gr.A,379.8± 18.8 mins in Gr B.($p<0.05$)The patients **first complained of pain** at the mean time of 239±22.4 minsin Gr A,1069±12.4 minsin Gr B($p<0.001$) In both groups,patients have stable haemodynamic parameters throughout the operation.supplementation of sedoanalgesia was **given** in 4 patients in the form of Injection Midazolam 1mg IV and Injection Fentanyl 50 microgm IV was given in

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2 patients and general anaesthesia was given in 2 patients in both groups.No other neurological complications were noticed in our study.
Conclusion: ultrasound guided Popliteal nerve block is safe& effective block for various ankle &foot surgeries. Dexamethasone is effective adjuvant in popliteal sciatic block for foot& ankle surgeries as it increase time to analgesic request.

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Introduction:-

The majority of the sensory and motor innervation of the foot and lower leg is provided by the sciatic nerve. There is a smaller sensory-only component, provided by saphenous nerve, which itself is derived from the femoral nerve. Blockage of the sciatic nerve in the popliteal fossa is a common technique to provide regional anaesthesia and analgesia for foot and ankle surgery.

Various authors have studied ultrasound guided regional Anaesthesia techniques for ankle& foot surgeries.(2-8)Regional anaesthesia at the knee has been resurrected from obscurity, evaluated and analysed in the literature during the past fifteen years.[19, 36, 39] In general, regional blockade is ideal for ambulatory type surgery. Advantages include perioperative analgesia and the avoidance of systemic complications like nausea and vomiting ,early discharge from post anaesthesia care unit and decreased opioid consumption perioperatively.[18]

There are several approaches to administer the popliteal sciatic nerve block. Commonly, a posterior approach is employed with the patient positioned prone. Alternatively, the lateral approach can be used with the patient in the supine position. The medial approach has been described in the literature, although it is utilized less frequently.[16]

The use of ultrasound allows direct real time visualization of the deposition of the local anaesthetic(LA) and so can improve the chance of successful nerve blockade.[45] Ultrasound also allowed dose reduction of the local anaesthetic(LA).[21] It reduces the block performance time, reduces the number of needle passes and shortens the block onset time.

Ultrasound guidance will allow the anaesthetist to detect this division and modify the procedure such that both branches are effectively blocked as well as the posterior femoral cutaneous nerve, a branch of the sacral plexus innervating posterolateral thigh segments that cannot be blocked by conventional means because it is separated from the sciatic nerve at the level of the proximal thigh[24]. Perineural dexamethasone increase analgesia.

Methods:-

The present study was conducted in 100 patients who underwent elective foot and ankle surgeries having ASA grades I, II and III.

Preanaesthetic assessment:
All patients were throughly acessed preoperatively,inform consent taken & VAS was explained in detail.

Inclusion criteria:
1. Patients with ASA grades I, II, III.
2. Patients willing to enroll in the study.
3. Surgeries on foot or ankle only.
4. Patients with age equal to or above 18.

Exclusion criteria:
Patients who do not give consent.
1. Patients with known bleeding disorders.
2. ASA grade more than III.

Pregnant women.
1. Patients who were having septicemia.

2. Patients with local site infections.
3. Mentally retarded patients

Preparation:
An intravenous line was secured with an 18G/20G intravenous cannula. Non invasive blood pressure monitoring and ECG monitoring was started. Pulse oximetry monitoring was also started Pre procedure and intraoperative vitals were noted.

Drugs prepared:
Gr.A: injection Lignocaine 1.5% 10 ml and injection Bupivacaine 0.5% 10 ml+2 ml normal saline
Gr.B: injection Lignocaine 1.5% 10 ml and injection Bupivacaine 0.5% 10 ml+ 2ml of 8 mg dexamethasone.

Anaesthesia workstation prepared for cardiopulmonary resucitation.

Ultrasound machine and its probe properly cleaned and aseptically prepared for the procedure.

Position:
Patient was positioned prone with head turned to the opposite side and hands kept by the side.

Landmarks:
Anatomical landmarks were identified and marked with a skin marker which included the course of the semitendinosus tendon and the biceps femoris tendon. The mid popliteal crease was identified and marked.

Procedure:-

Block was performed by consultant anaesthetists who have given atleast ultrasound guided 30 blocks,& having ethical clearence & license to use ultrasound machine for perpetual nerve block to avoid any medico-legal issues. After preparing the parts with iodine, spirit and normal saline solutions, proper draping was done and a high frequency (5-12 Hz) ultrasound probe was placed transversely at the mid popliteal crease. After localizing the popliteal artery it was moved proximally to locate the sciatic nerve at or prior to its bifurcation into the tibial and peroneal branches. A 23G spinal needle was inserted using out of the plane approach. The needle tip was advanced until it reached very close to the nerve visualized as a bright dot. Once placement was confirmed by questioning the patient verbally regarding the presence of paraesthesia in the foot and ankle region, according to group allocation drug was injected.

Sensory block was assessed by Hollmen scale[40] and motor block was assessed by the ability to plantar flex the ankle(using the Hollmen scale)[40]. Monitoring was carried out and all the data was entered into a spreadsheet program. Time taken for sensory and motor blockade to recede completely was noted and also was the time taken till the onset of pain postoperatively. Below are reference diagrams illustrating the same.

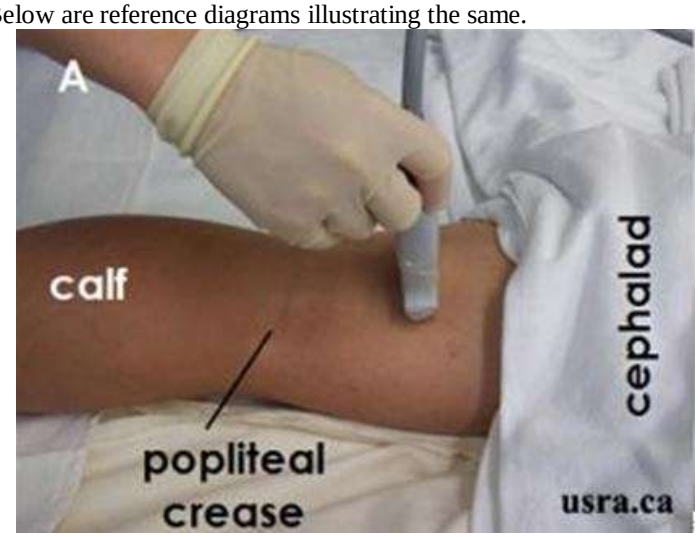

Figure 4:-

Figure 5:- BF:biceps femoris. ST, SM: semimembranosus, semitendinosus.

Figure 6:-

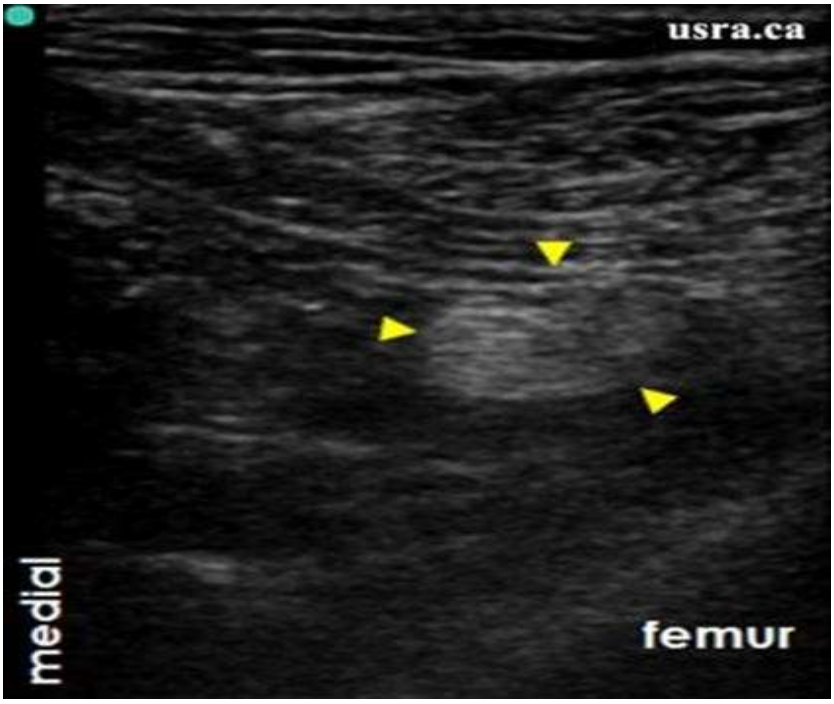

Figure 7:- Figure shows the sciatic nerve (arrow heads) in the popliteal fossa before it divides.

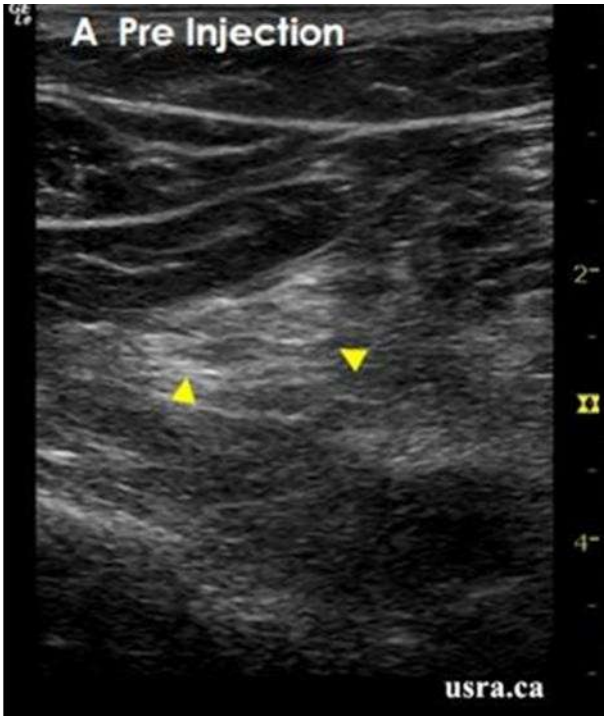

Figure 8:- Injection of anaesthetic agent was confirmed by visualization.

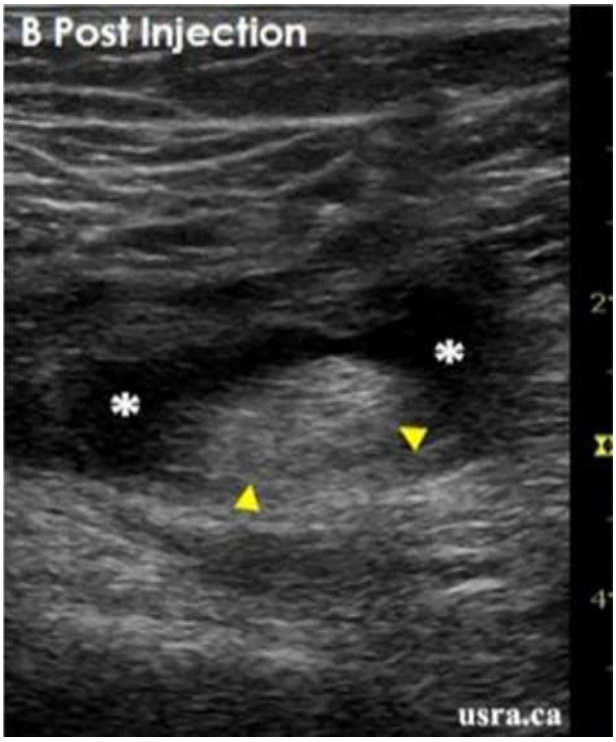

Figure 9:- Stars showing deposition of local anaesthetic agents.

Following parameters were noted:
1. Time taken for the procedure
2. No of attempts neede to localize the sciatic nerve
3. Onset and duration of sensory blockade.
4. Onset and duration of motor blockade.
5. Need of supplementary sedation/general anaesthesia.
6. Onset of pain for the first time post procedure.

Definitions Of Parameters:
Procedure time)Time taken for the procedure): \
Interval between preparation of the local part and administration of the full dose of the local anaesthetic.

Number of attempts:
The number of times the skin has to be punctured with the Quincke spinal needle to localize the sciatic nerve and inject the full dose of the local anaesthetic agents.

Onset of sensory blockade:
Interval between injection of the full dose of local anaesthetic agents to the complete loss of pinprick sensation over the ankle and the foot.

Onset of motor blockade:
Interval between injection of full dose of local anaesthetic agents to the complete inability to plantar flex the ankle.

Duration of sensory blockade:
Interval between onset of sensory block to the first time pin prick sensations are felt again by the patient on periodic checking.

Duration of motor block:
Interval between onset of motor block to the time when the patient is able to plantar flex the ankle.

Failure of block:
inadequate analgesia, sensory blockade or motor blockade even after 30 minutes of injection of local anaesthetic solution. It was managed by giving **supplementation** in the form of anxiolytics like Injection Midazolam 1 mg IV and Injection Fentanyl 50microgm IV in anxious patients or with general anaesthesia.

Onset of pain:
Interval between onset of sensory block and the first time when the patient complains of pain.
Evaluation of sensory block(hollmen scale)[40]:

1. normal sensation of pin prick
2. pin prick felt as sharp pointed but weaker compared with same area in the upper limb
3. pin prick perceived as touch with blunt object
4. complete loss of pin prick sensation

Evaluation of motor block(hollmen scale)[40]:

1. normal muscle function
2. slight weakness in function
3. very weak muscular f unction
4. complete loss of function.

After completion of surgery, patient was shifted to Post operative ward and watched for regression of sensory and motor blockade periodically. Vitals were also recorded. When VAS was greater than 4 rescue analgesia in the form of Injection Tramadol 50mg IV given. Time to rescue analgesia was noted. Patients were further managed conventionally according to the department protocol.

Statastical Analysis
All the data was entered in a spreadsheet program and statistical analysis were done using microsoft excel version 2019 16.0.6742.2048 software.

Observations & Results:-

Table 1:- Demographic parameters.

DEMOGRAPHIC PARAMETERS	GROUP A (N=50)	GROUP B (N=50)	PVALUE	INFERENCE
AGE(YRS)	52.8 ±6.7	50±8.2	>0.05	NS
GENDER(M:F)	34:16	30:20	>0.05	NS
WEIGHT(KG)	70±18	66±20	>0.05	NS
ASA GRADE (I/II/III)	20/12/16	22/14/14	>0.05	NS
DURATION OF SURGERY(MINS)	64±12	68±14	>0.05	NS

Inteaoperatively in operation theatre ,After the operation, in post operative ward, as block effect weared off the patients' haemodynamic parameters were raised slightly above the baseline.(p>0.05)

Table 2:- Sensory Moter Charisteristics.

PARAMETERS (MINS)	GR A(N=50) N=50	GR B(N=50) N=50	P VALUE	INFERENCE
PERFORMANCE RIME	4.3±1.4	,4.2±1.6	**>0.05**	**NS**
ONSET OF SENSORY BLOCKAGE	3.8±1.1	3.6±1.4	**>0.05**	**NS**
ONSET OF MOTOR BLOCKAGE	7.2± 1.4	7..0± 1.5	**>0.05**	**NS**
MOTOR REGRESSION	143.8±13.5	340.8±10.5	**<0.05**	**S**

SENSORY REGRESSION	184.8± 16.8	379.8± 18.8	**<0.05**	**S**
TIME TO FIRST RESCUE ANALGESIA	239±22.4	1069±12.4	**<0.001**	**HS**

*NS-NONSIGNIFICANT,S-SOGNIFICANT,HS- HIGHLY SIGNIFICANT

Complications:

Failure of blockage and supplementation required

No cases can be considered a failure**.** Because two patients were managed with sedation and analgesia by Injection Midazolam 1mg IV and Injection Fentanyl 50microgm IV. No patient in any group required general anaesthesia.

Haemodynamic complications:

Haemodynamic parameters were near baseline and normal

Neurological complications:

No neurological sequalae was observed in any case in my study.

Discussion:-

The popliteal nerve block is a form of regional anesthesia utilized for a variety of foot and ankle conditions. This form of anesthesia has become a popular technique to decrease postoperative pain, decrease narcotic use, and increase patient satisfaction. This is evident by an increase in published techniques within foot and ankle literature in the 21st century. [10] Furthermore, a publication by Hegewald et al. has demonstrated that not only is the popliteal block highly efficacious, but can also be executed by the novice foot and ankle surgeon. Popliteal blocks can potentially be utilized as the sole source of anesthesia for foot and ankle surgery. This can be beneficial in medically compromised patients. Profound analgesia during both the operative and postoperative time periods and the avoidance of systemic complications such as nausea and vomiting are also potential benefits of the popliteal nerve block. Other advantages include earlier discharge from the post-anesthesia care unit and decreased opioid consumption perioperatively[7].

We studied 100 randomly selected patients who were undergoing ankle and foot surgeries and administered ultrasonography guided popliteal nerve block. We monitored them closely and analyzed the data obtained.

Demographic parameters:

In our study, ASA grade I/II/III patients were enrolled (table 1).

It is comparable to study of Van Geffen GJ, van den Broek E, Braak GJ, Giele JL, Gielen MJ, Scheffer GJ(2009)[45] who studied the effect of Ultrasound-Guided Popliteal Sciatic Block with a Single Injection at the Sciatic Division.

It is also comparable to Maalouf D, Liu SS, Movahedi R, Goytizolo E, Memtsoudis SG, et al. (2012)[23] who studied Nerve stimulator versus ultrasound guidance for placement of popliteal catheters for foot and ankle surgery.

Technique Of Blockage:

We have used ultrasound as a tool to give popliteal nerve block.

Perlas A, Brull R, Chan VW, et al.(2008)[31], Mariano ER, Cheng GS, et al.(2009)[25], Van Geffen GJ, et al(2009)[45] and Gelfand HJ, Ouanes JP, Lesley MR, Ko PS, et al.(2011)[14] all concluded that when compared to neurostimulation or other techniques, ultrasound has a higher success rate, faster onset, a less painful application, faster progression of sensory motor block, all without an increase in block procedure time or complications.

Maalouf D, Liu SS, Movahedi R, Goytizolo E, Memtsoudis SG, et al.(2012)[23] and Dufour E, Quennesson P, Van Robais AL, Ledon F, Laloë PA, et al.(2008)[12] concluded that with ultrasonography, less anesthetic is required without any compromise in efficacy.

Volume Of Local Anaesthetic Solution Used:

In our study, we have used 10ml of lignocaine (1.5%) and 10ml Bupivacaine(0.5%) and total volume of LA is 20ml in both groups,gr.A has 2 cc NS& gr.B has 2 ml of 8 mg dexamethasone as adjuvant.

It is comparable to that suggested by, Southerland JT, Boberg JS, Downey MS, Nakra A (2009)[41], who have suggested to use 20-30 cc of local anaesthetics which includes injection bupivacaine(0.5%) and injection lignocaine

(1.5%). But it is more than the study by Techasuk, Wallaya et. al.(2014)[43] who concluded that for ultrasound-guided subparaneural (analgesic) popliteal sciatic nerve block, the MEV90 of combined lidocaine 1.0%–bupivacaine 0.25% with epinephrine 5 μg/mL is 13.3 mL (95% confidence interval, 10.2–16.4 mL).

KeAn,NabilM.Elkassabany,JiabinLiuetal,(2015)(48)in their study showed comparison of different dose of Dexamethasone 0.14mg/kg and 0.5 mg/kg combined with Bupivacaine for sciatic nerve block demonstrated that Perineural Dexamethasone prevent axonal degenerationand demyelination and no significant caspase dependent apoptosis processin themouse sciatic nerve among all study.

Performance Time(Time Taken To Execute The Block:)As shown in table2,
It was comparable to the study by HadzicA, Vloka JD[17] and Zetlaoui[47] who reported the average time to perform a popliteal fossa block was 4.10 minutes, and the motor blockade was complete in all patients within thirty minutes.

Duration Of Sensory And Motor Blockade
As shown in table 2 ,sensory & motor regression& time to rescue analgesia were prolonged in gr.B ,it is due to perineural effects of dexamethasone.

It was less than that studied by Taboda, Muniz M, et al(2003)[42], who studied the lateral approach to sciatic nerve block in the popliteal fossa and concluded that Onset of complete sensory and motor blockade of the foot was 16.6 +/- 5.1 minutes, 20.1 +/- 5.1 minutes respectively using single injection of 30 mL of ropivacaine 0.75%.

Such a difference was observed probably due to the different drugs used in our study as we have used a mixture of Injection lignocaine(1.5%) 10ml and Injection bupivacaine(0.5%) 10ml.

Duration Of Complete Motor And Sensory Regression
These times were much prolonged than ones encountered in existing studies. This could be attributable to excessive tolerance to pain found in the Indian patients as compared to their western counterparts

Philips (2011)[32] performed a retrospective review on treatment of sixteen patients in the emergency department using nerve-stimulator assisted and nonstimulating (ultrasound guided) popliteal blocks. Cases included procedures of leg, ankle, and foot such as fracture reduction, splinting, irrigation, and debridement. In addition to high efficiency, there was a high degree of patient satisfaction. Post procedural anesthesia lasted 90 to 120 minutes in all cases. It was concluded that this technique offers the advantage of relative cardiopulmonary safety, dense and prolonged analgesia, and maintenance of normal airway reflexes in patients with increased aspiration risk. When comparing two stimulating groups with one non-stimulating group, higher visual analog scores were recorded in the non-stimulating(ultrasound) group at 6-8 hours and 19-23 hours.

Hemodynamic Stability:
There was stable haemodynamic parameters in each patient in both groups.

It is comparable to study by Brown et al.(1992)[5] who concluded that Intra-operative and post-operative hemodynamic disturbances are minimized as a result of this blockade.

Complications:
In our study, Four patients have failure of block. The possible attributing factors could have been improper isolation of the nerve, faulty injection, migration of the needle during drug injection or incorrect identification of the nerve itself.

Two need sedation and two need general anaesthesia for supplementation to conduct the surgery. No neurological complications or complications regarding the drug adverse effects were noted
Rogobete AF, Bedreag OH et al.(2015)[35] and Hajek V, Dussart C, et al.(2012)[18] reported that complications from popliteal nerve blocks are uncommon as the reported rate is 0-10%. The most common complications include incomplete anesthesia, infection, and neuropraxia.

Hajek(18) performed a retrospective study of 157 procedures where a continuous popliteal nerve block was used for hallux valgus surgery. He reported a complication rate of 1.26% in the form of postoperative peripheral neuropathy, complete block failure in 4%, and partial failure in 10%.

Canales MB et. al. (2015)[7] concluded that popliteal blocks have shown to decrease the amount of perioperative opioid consumption. This can aid in limiting opioid related complications including nausea and vomiting, respiratory depression, constipation, and dependency. Symptoms from general, spinal, or epidural anesthesia include pain, postoperative nausea and vomiting, urinary retention, as well as respiratory and hemodynamic instability. These complications were not noted in our study as we have used ultrasound guided local anaesthetic agent. Many of these issues can be circumvented with the popliteal sciatic nerve block.

Conclusion:-

In nutshell,Ultrasonography guided popliteal nerve block is an effective and successful alternative technique to provide perioperative sensory and motor blockage with less volume of LA, faster onset with virtue of post-operative analgesia with minimum adverse effects even in high risk patients undergoing various ankle and foot surgeries & usage of perineural dexamethasone for this block increase sensorimotor block & improve postoperative analgesia.

References:-

1. Adam Aubuchon, W. David Arnold and J. Chad Hoyle(2017) https://doi.org/10.1002/mus.25622.
2. Adibatti M, Sangeetha V. Study on variant anatomy of sciatic nerve. J Clin Diagn Res. 2014;8:AC07-AC09.
3. Adriani J. Labat's Regional Anesthesia.Techniques and Clinical Applications., W.B. Saunders Company, Philadelphia, pp 317-21, 1967.
4. Beskin JL, Baxter, DE: Regional anesthesia for ambulatory foot and ankle surgery. Orthopedics 10:109, 1987
5. Brown, DL: "Popliteal Block, " in Atlas of Regional Anesthesia, ed by DL Brown, WB Saunders, Philadelphia, p 109, 1992.
6. Brull R, Macfarlane AJR, Parrington S, et al. Is circumferential injection advantageous for ultrasound-guided popliteal sciatic nerve block?: a proof-of-concept study. Reg Anesth Pain Med. 2011;36(30):266-270.
7. Canales MB, Huntley H, Reiner M. Ehredt DJ, Razzante M(2015) The popliteal nerve block In Foot and Ankle Surgery: an Efficient and Anatomical Technique. J Anesth Clin Res 6:553. Doi:10.4172/2155-6148.1000553.
8. Carty S, Nicholls B, Ultrasound-guided regional anaesthesia, Contin Educ Anaesth Crit Care Pain(2007) 7 (1):20-24
9. Chan VW, Nova H, Abbas S, et al. Ultrasound examination and localization of the sciatic nerve: a volunteer study. Anesthesiology 2006; 104: 309– 14.
10. Creech C, Meyr AJ (2013) Techniques of popliteal nerve regional anesthesia. J Foot Ankle Surg 52: 681-685.
11. Danelli G, Fanelli A, Ghisi D, et al. Ultrasound vs nerve stimulation multiple injection technique for posterior popliteal sciatic nerve block. Anaesthesia. 2009;64(6):638-642.
12. Dufour E, Quennesson P, Van Robais AL, Ledon F, Laloe PA, et al.(2008) Combined ultrasound and neurostimulation guidance for popliteal sciatic nerve block:a prospective, randomized comparision with neurostimulation alone.AnaesthAnalog 106:1553-1558, table ofcontents.
13. Gallardo J, Lagos L, Bastias C, Henríquez H, Carcuro G, et al. (2012) Continuous popliteal block for postoperative analgesia in total ankle arthroplasty. Foot Ankle Int 33: 208-212.
14. Gelfand HJ, Ouanes JP, Lesley MR, Ko PS, Murphy JD, et al(2011). Analgesic efficacy of ultrasound-guided regional anaesthesia:a meta-analysis.J clinAnesth 23:90-96.
15. Gray H. Gray's Anatomy of the Human Body 20th ed. (1918). New York, NY: Bartleby; 2000.
16. Guntz E, Herman P, Debizet E, Delhaye D, Coulic V, et al. (2004) Sciatic nerve block in the popliteal fossa: description of a new medial approach. Can J Anaesth 51: 817-820
17. HadzicA, Vloka JD (1998) A comparison of the posterior versus lateral approaches to the block of the sciatic nerve in the popliteal fossa. Anesthesiology 88: 1480-1486.
18. Hajek V, Dussart C, Klack F, Lamy A, Martinez JY, et al. (2012) Neuropathic complications after 157 procedures of continuous popliteal nerve block for hallux valgus surgery. A retrospective study. OrthopTraumatolSurg Res 98: 327-333.
19. Hansen E, Eshelman MR, Cracchiolo A 3rd (2000) Popliteal fossa neural blockade as the sole anesthetic technique for outpatient foot and ankle surgery. Foot Ankle Int 21: 38-44.
20. Hegewald K, McCann K, Elizaga A, Hutchinson BL (2014) Popliteal blocks for foot and ankle surgery: success rate and contributing factors. J Foot Ankle Surg 53: 176-178.

21. Koscielniak-Nielsen ZJ.Ultrasound-guided peripheral nerve blocks: what are the benefits? Acta Anaesthesiol Scand.2008 Jul; 52(6):727-37.doi:10.1111/j.1399-6576.2008.01666.x.E pub 2008 May 12.Review
22. Lee JH, Lee BN, Lee My, An X, Han SH(2013) The significance of tibial and common peroneal nerves in nerve blocks. Surg Radiol Anat 35:211-215
23. Maalouf D, Liu SS, Movahedi R, Goytizolo E, Memtsoudis SG, et al. (2012) Nerve stimulator versus ultrasound guidance for placement of popliteal catheters for foot and ankle surgery. J ClinAnesth 24: 44-50.
24. Marhofer P, Grehner M, Kapral S. Br. J. Anaesth. (2005) 94 (1): 7-17.doi: 10.1093/bja/aei002.
25. Mariano ER, Cheng GS, Choy LP, Loland VJ, Bellars RH, et al. (2009) Electrical stimulation versus ultrasound guidance for popliteal-sciatic perineural catheter insertion: a randomized controlled trial. RegAnesth Pain Med 34: 480-485.
26. Miller S.J. D.P.M. Chapter 43:Use of popliteal Blocks in Foot and Ankle surgery, p 220-223, 2001.
27. Miller, Ronald D. (November 2, 2006). Basics of Anesthesia. Churchill Livingstone.
28. Moore KL, Agur AM. Essential Clinical Anatomy. 2nd ed. Philadelphia, PA: Lippincott Williams and Wilkins; 2002
29. Moore, Clinically Oriented Anatomy, 6th edition.
30. Neal Joseph M et al(2016). Regional Anesthesia & Pain Medicine: March/April 2016 - Volume 41 - Issue 2 - p181–194 doi: 10.1097/AAP.0000000000000331
31. Perlas A, Brull R, Chan VW, McCartney CJ, Nuica A, et al. (2008) Ultrasound guidance improves the success of sciatic nerve block at the popliteal fossa. RegAnesth Pain Med 33: 259-265.
32. Phillips WJ, Troutman G, Lerant A (2011) Nerve stimulator-assisted sciatic nerve block for painful procedures in the ED. Am J Emerg Med 29: 1130-1135.
33. Provenzano DA, Viscusi ER, Adams, SBJr, Kerner, M, Abidi NA. The safety and efficacy of the popliteal fossa nerve block for foot and ankle surgery. American Orthopaedic Foot and Ankle Society 31st Annual Meeting, San Francisco, CA, March 2001.
34. Rodríguez J, Taboada M, Carceller J, Lagunilla J, Bárcena M, et al. (2006) Stimulating popliteal catheters for postoperative analgesia after hallux valgus repair. AnesthAnalg 102: 258-262.
35. Rogobete AF, Bedreag OH, Sarandan M, Papurica M, Preda G, et al. (2015) Liposomal bupivacaine - New trends in Anesthesia and Intensive Care Units. Egyptian Journal of Anaesthesia 31: 89-95.
36. Rorie DK, Byer DE, Nelson DO, et al: Assessment of block of the sciatic nerve in the popliteal fossa. Anesth Analg 59:371-6, 1980.
37. Saleh HAM, El-fark MMO, Abdel-Hamid GA. Anatomical variation of sciatic nerve division in the popliteal fossa and its implication in popliteal nerve blockade. Folia Morphol. 2009;68: 256-259.
38. Salinas FV Evidence Basis for Ultrasound Guidance for Lower-Extremity Peripheral Nerve Block: Update 2016 Regional Anesthesia & Pain Medicine 2016;41:261-274.
39. Schimek F, Deusch H: New technique of sciatic nerve block in the popliteal fossa. Eur J Anaesth 12:163-169, 1995.
40. Sites, Brian D.; Chan, Vincent W.; Neal, Joseph M. ; Weller, Robert; Grau, Thomas MD; Koscielniak-Nielsen, Zbigniew J.; Ivani, Giorgio.The American Society of Regional Anesthesia and Pain Medicine and the European Society of Regional Anaesthesia and Pain Therapy Joint Committee Recommendations for Education and Training in Ultrasound-Guided Regional Anesthesia, Regional Anesthesia and Pain Medicine, Volume 34, issue 1, January-February 2009:40-46.
41. Southerland JT, Boberg JS, Downey MS, Nakra A(2009). The Podiatry Institute, Southerland JT, Boberg JS, Downey MS, Nakra A (2009) Local Anesthetics: McGlamry's Comprehensive Textbook of Foot and Ankle Surgery. (4thedn), Lippincott Williams & Wilkins, Philadelphia.
42. Taboda, Muniza M, a Lvarez J, cortes, Atanassoff PG(2003) Lateral approach to the sciatic nerve block in the popliteal fossa: correlation between evoked motor response and sensory block. Reg Anesth Pain Med 28:450-455.
43. Techasuk, Wallaya et.al. Regional Anesthesia & Pain Medicine: March/April 2014 - Volume 39 - Issue 2 –p 108–111 doi: 10.1097/ AAP.0000000000000051.
44. Tomaszewski KA, Graves MJ, Henry BM, et al. Surgical anatomy of the sciatic nerve: a meta-analysis. J Orthop Res. 2016;34:1820-1827.
45. Van Geffen GJ, van den Broek E, Braak GJ, Giele JL, Gielen MJ, et al. (2009) A prospective randomised controlled trial of ultrasound guided versus nerve stimulation guided distal sciatic nerve block at the popliteal fossa. Anaesth Intensive Care 37: 32-37.
46. WHO Model List of EssentialMedicines" (PDF). World Health Organization. October 2013. Retrieved 22 April 2014

47. Zetlaoui PJ, Bouaziz H (1998) Lateral approach to the sciatic nerve in the popliteal fossa. AnesthAnalg 87: 79-82.
48. Ke An, Nabil M. Elkassabany, Jiabin Liu et al, (2015) Dexamethasone asAdjuvanttoBupivacaine Prolongsthe Duration of Thermal Antinociception and Prevents Bupivacaine-Induced ReboundHyperalgesiaviaRegionalMechanisminaMouseSciatic Nerve Block Model. April 9, 2015. https://doi.org/