EUROPEAN JOURNAL OF BIOMEDICAL AND PHARMACEUTICAL SCIENCES
http://www.ejbps.com

ISSN 2349-8870
Volume: 8
Issue: 9
140-144
Year: 2021

PERINEURAL DEXAMETHASONE AND REBOUND PAIN FOLLOWING BUPIVACAINE SUPRACLAVICULAR BRACHIAL PLEXUS BLOCKADE

Sadeq M. Da'meh MD*, Rami A. Abudayyeh MD, Anan H. Qabaha MD, Mohammad J. Beidas MD, Thani O. Al Awamreh MD, Mohammad A. Adaileh MD, Nidal M. Al Soud MD, Moath M. Kreshan MD, Trad M. Al Halahlah MD

Rusaifah, Amman, Jordan.

***Corresponding Author: Sadeq M. Da'meh MD**
Rusaifah, Amman, Jordan.

Article Received on 05/07/2021 **Article Revised on 25/07/2021** **Article Accepted on 15/08/2021**

ABSTRACT

Background: Rebound pain following supraclavicular brachial plexus blockade is considered a serious limitation. Inadequate management is the most important cause of the rebound within peripheral nerve blockade diminishing. **Objective:** We determined whether perineural dexamethasone can reduce the frequency of rebound pain following bupivacaine supraclavicular brachial plexus blockade. **Methods:** This prospective, double-blinded and randomised investigation included 116 patients, of both sexes, aged 23–65 yrs., classed I-III by the American Society of Anaesthesiologists and assigned for upper limb surgical orthopaedic procedures using supraclavicular brachial plexus blockade at Royal Rehabilitation Centre, Amman, Jordan, during the period Jan 2020-Jan 2021. Group I patients (GI, n = 59) were administered 0.5% bupivacaine mixed with 6 mg dexamethasone, and Group II patients (GII, n = 57) were administered bupivacaine 0.5%. Rebound pain frequency 3 days following supraclavicular brachial plexus blockade was rated using a numeric rating scale pain score during 6, 16, 28 and 48 hrs. following the supraclavicular brachial plexus blockade, pain and paraesthesia within 2 weeks post-operation were. The Mann-Whitney U test was used for the continuous variables and the chi-square test to evaluate the correlation between the categorical variables. **Results:** The frequency of rebound pain was remarkably lower in Group I (6/59 [10.2%]) compared to Group II (27/57 [47.3%]); $P < 0.005$. Group allotment was correlated with rebound pain [OR = 0.041]. Patients in Group I had significantly lower numeric rating scale pain scores [4] compared to Group II [7] ($P < 0.005$). Regarding NRS pain scores after surgery, there was a remarkable discrepancy between groups only at 16 h after blockade, at rest ($P < 0.05$) and on movement ($P < 0.005$). **Conclusions:** Perineural 6 mg dexamethasone decreases rebound pain following supraclavicular brachial plexus blockade during upper limb operative orthopaedic techniques.

KEYWORDS: Supraclavicular brachial plexus blockade: bupivacaine, dexamethasone; Pain: rebound, numeric rating scale scores.

INTRODUCTION

Peripheral nerve blockade has an important part in multimodal pain relief, attaining optimum early pain control after surgery.[1] Rebound pain after peripheral nerve blockades is an important limitation regarding this procedure.[1] Rebound pain is a frequent factor of unscheduled readmission[2] and was recorded following an ankle fracture operation using popliteal sciatic nerve blockade[3], distal radius fracture fixation using supraclavicular brachial plexus blockade[4] and shoulder arthroscopy using interscalene brachial plexus blockade.[5]

Uncomplacent management is the most important cause of the rebound within peripheral nerve blockade diminishing. The pain breach occurs nocturnal. Maintaining infusion via the perineural catheter can decrease the frequency of rebound pain[6], but with unfortunate dislocation and local infection. Perineural liposomal bupivacaine via interscalene nerve blockade may induce excellent analgesia with less narcotics after surgery. Liposomal bupivacaine with standard bupivacaine used for interscalene brachial plexus blockade was compared with standard bupivacaine for pain control following shoulder operation.[7] The most severe pain was less during the first 7 days for liposomal bupivacaine (mean of 3.6 compared to 5.3). Safe and potent supporting of local anaesthetics might be an important protocol to avoid rebound pain. Dexamethasone lengthens the period of brachial plexus blockade, with no side effects. Perineural dexamethasone with bupivacaine can lengthen the period of sensory and motor blockade, avoiding bupivacaine-caused reversible neurotoxicity and shortening rebound hyperalgesia.[8]

The goal of this investigation was to assess whether perineural dexamethasone can reduce the frequency of rebound pain following bupivacaine supraclavicular brachial plexus blockade.

Methods

Our prospective, double-blind and randomised investigation included 116 patients, of both sexes, aged 23–65 yrs., classed I–III by the American Society of Anaesthesiologists and assigned for upper limb surgical orthopaedic procedures using supraclavicular brachial plexus blockade ultrasound-directed at Royal Rehabilitation Centre, Amman, Jordan, during the period Jan 2020-Jan 2021. The patients were assigned to two groups after providing written informed consent. This study was approved by our local ethical and research board review committee of the Jordanian Royal Medical Services. Group I patients (GI, n = 59) were administered 35 ml of 0.5% bupivacaine mixed with 6 mg dexamethasone, and Group II patients (GII, n = 57) received 35 ml of 0.5% bupivacaine. Patients with multiple insults, nerve insult before surgery, hypersensitivity to bupivacaine or dexamethasone or long-standing analgesic use were excluded.

Ultrasound was performed with a high-frequency linear probe. The blockade was assessed according to sensation of a pin prick 45 min following the blockade. Pain severity was assessed using NRS (0–10). Moderate or severe pain was recorded. Rebound pain was recorded as severe sudden pain not ameliorated in 45 min (NRS more than 7). Rebound pain frequency 3 days following supraclavicular brachial plexus blockade, the period from the blockade when the most intense pain occurred, numeric rating scale pain score during 6, 16, 28 and 48 hrs following the supraclavicular brachial plexus blockade, pain and paraesthesia within 2 weeks post-operation were recorded.

Statistical analysis

The Mann-Whitney U test was used to analyse the continuous variables. We applied the chi-square test to evaluate the correlation between categorical parameters. The variance of repeated measurements was used for the NRS scores pre- and post-operatively.

RESULTS

There were no remarkable discrepancies between the two groups regarding demographics as well as aesthetic and operative features (Table I). The supraclavicular brachial plexus blockade induced optimum anaesthesia for all patients. The frequency of rebound pain was remarkably lower in Group I [6 (10.2%)] compared to Group II [27 (47.3%)]; the relative risk (RR) was 0.197, $P < 0.005$. There were discrepancies between groups regarding pain features as soon as the supraclavicular brachial plexus blockade faded. The peak NRS pain scores were 4 in Group I and 7 in Group II ($P < 0.005$). Patients in Group I had a peak pain score at 17.4 from the blockade. Patients in Group II had the most intense pain score at 12.3 from the blockade (Table II).

We observed remarkable correlations between rebound pain and group allotment ($P < 0.005$), tourniquet ($P > 0.05$) and NRS pain score with movement before surgery: Mild (NRS 1–3) $P > 0.05$, Moderate (NRS 4–6) $P > 0.05$ and Severe (NRS 7–10) $P > 0.05$ before blockade. Only group allotment was remarkably associated with rebound pain (Table III). Dexamethasone with bupivacaine could prevent rebound pain. There was a remarkable discrepancy regarding NRS pain scores between both groups (resting: $P < 0.005$; in movement: $P < 0.05$). Regarding NRS pain scores after surgery, there was a remarkable discrepancy between groups only at 16 h after blockade, at resting ($P < 0.05$) and during movement ($P < 0.005$). At 2 weeks post-operation, there was no paraesthesia or chronic pain at the operative location.

Table I: Demographics as well as aesthetic and operative features.

	G I	G II	P
n	59	57	
Agents	Dexamethasone 6 mg Bupivacaine 0.5%, 35 ml	Bupivacaine 0.5%, 35 ml	
Age (yrs.)	49.3	47.8	
Sex (no.) M	21	23	
F	38	34	
ASA (no.) I	31	33	
II	15	12	
III	13	12	
Period from insult to operation (days)	4.9	5.8	>0.05
Tourniquet (no.) **YES**	29	21	>0.05
NO	30	36	

Table II. Peak NRS pain scores in the first 3 days following the blockade.

Hours from blockade									
		6		16		28		48	
		G I	G II	G I	G II	G I	G II	G I	G II
Peak NRS pain scores	1	yes	yes		yes				
	2		yes		yes				
	3	yes	yes		yes	yes	yes		
	4	yes	yes	yes	yes	yes	yes		
	5	yes	yes	yes	yes	yes			
	6			yes	yes	yes	yes		yes
	7	yes	yes	yes	yes		yes		
	8	yes		yes	yes	yes			
	9	yes		yes	yes		yes		
	10	yes		yes					yes

Table III.NRS pain scores during surgery.

Hours from blockade						
Before surgery	Hr.	0	6	16	28	48
NRS pain scores	0		DBR			
	1	DBR BR	BR BM DBM	DBR DBM		BR
	2			BR	BR DBM DBR	DBR BM DBM
	3			BM	BM	
	4	BM				
	5	DBM				
	6					
	7					
	8					
	9					
	10					

BR: bupivacaine on rest
DBR: dexamethasone with bupivacaine on rest
BM: bupivacaine on movement
DBM: dexamethasone with bupivacaine on movement

DISCUSSION

Perineural dexamethasone may lengthen the sensory blockade period. We found that mixing 0.5% bupivacaine with 6 mg dexamethasone can decrease the frequency of rebound pain in the upper limb after different orthopaedic procedures under supraclavicular brachial plexus blockade. Dexamethasone diminished pain severity at the main intense pain sites. Rebound pain after brachial plexus blockade is an important issue which reduces the advantages of blockades.[2] Different pain features were found following general anaesthesia in comparison to plexus blockade. Patients with brachial plexus blockade experienced less pain postoperatively, 12 and 24 h later as soon as the block diminished, but the pain was more than that experienced by the general anaesthetic group.[4]

The diminution of nerve blockade cannot interpret the inability of some patients to feel severe pain when the blockade disappears. Rebound pain cannot be managed by intravenous opiates[1] and features severe burning pain, primarily when the blockade diminishes.[1] A neuropathic rather than a nociceptive element of rebound pain following blockade could be incriminated. Local anaesthetics may induce nerve swelling, modifying the permeability of the external nerve membrane, causing pathological nerve conduction.[1] Local anaesthetic toxicity and proinflammatory action of local anaesthetics could cause rebound pain.[9] Dexamethasone is a strong and long-acting glucocorticoid. It lengthens the period of blockade compared to only local anaesthetics[1] by decreasing the production of inflammatory mediators, ectopic neuronal discharge and potassium channel-mediated discharge of nociceptive C-fibres.[10] Perineural dexamethasone with bupivacaine avoided bupivacaine-caused reversible neurotoxicity and short-term "rebound hyperalgesia".[8] Our investigation showed that 6 mg of dexamethasone with 0.5% bupivacaine diminished the frequency of rebound pain from 47.3 to 10.2% following upper limb orthopaedic surgical techniques under supraclavicular brachial plexus blockade.

Mixing 2 mg of perineural dexamethasone caused better rebound pain features than no dexamethasone or 4 mg perineural dexamethasone.[11] The dose of dexamethasone used perineurally was 4–10 mg[12]; 4 mg perineural dexamethasone is a ceiling dose lengthening the pain relief period.[13] The internal fixation rebound feature was less in patients aged more than 60 years, mostly with moderate pain (NRS 4–6) when the blockade diminished.[2] There was no correlation between rebound pain frequency and age in our investigation, but patients younger than 60 years experienced a higher frequency of rebound pain. Rebound pain is defined as a measurable discrepancy between the peak NRS pain score when the blockade diminishes and the final NRS pain score when the blockade is still functioning.[1] It generally occurs suddenly, at night or by motion. Rebound pain can also be defined as intense pain (NRS pain score more than 7) that appears within 2 days following blockade, at rest or by motion, and cannot be managed via opiates. Dexamethasone lengthens the blockade period. Sometimes, the burning or aching pain features cannot be found.

Dexamethasone is one of the main frequent adjuvants to blockades. An increase in blood glucose serum level has been recorded with dexamethasone and requires insulin management.[14] In our investigation, the influence of intravenous dexamethasone on rebound pain was not evaluated. The decrease in rebound pain could either be due to perineural or systemic absorption of dexamethasone and whether the lengthening of the blockade is due to systemic or perineural mechanisms. For bupivacaine, mixing with perineural dexamethasone statistically significantly lengthened the pain relief period by 21% compared with intravenous use.[15] Intravenous dexamethasone is a potent anti-inflammatory agent.

CONCLUSION

Mixing 6 mg dexamethasone with bupivacaine decreased rebound pain following a supraclavicular brachial plexus blockade in various upper-limb orthopaedic operative procedures. It decreased the pain severity at the main intense pain points.

REFERENCES

1. Jie F, Yuncen S, Fang D, et al. The effect of perineural dexamethasone on rebound pain after ropivacaine single-injection nerve block: a randomized controlled trial. BMC Anesthesiology, 2021; 21: 47.
2. Sort R, Brorson S, Gogenur I, et al. Rebound pain following peripheral nerve block anaesthesia in acute ankle fracture surgery: an exploratory pilot study. Acta Anaesthesiol Scand, 2019; 63(3): 396–402.
3. Goldstein RY, Montero N, Jain SK, et al. Efficacy of popliteal block in postoperative pain control after ankle fracture fixation: a prospective randomized study. J Orthop Trauma, 2012; 26(10): 557–61.
4. Galos DK, Taormina DP, Crespo A, et al. Does brachial plexus blockade result in improved pain scores after distal radius fracture fixation? A randomized trial. Clin Orthop Relat Res., 2016; 474(5): 1247–54.
5. DeMarco JR, Componovo R, Barfield WR, et al. Efficacy of augmenting a subacromial continuous-infusion pump with a preoperative interscalene block in outpatient arthroscopic shoulder surgery: a prospective, randomized, blinded, and placebo-controlled study. Arthroscopy, 2011; 27(5): 603–10.
6. Ding DY, Manoli A 3rd, Galos DK, et al. Continuous popliteal sciatic nerve block versus single injection nerve block for ankle fracture surgery: a prospective randomized comparative trial. J Orthop Trauma, 2015; 29(9): 393–8.
7. Vandepitte C, Kuroda M, Witvrouw R, et al. Addition of liposome bupivacaine to bupivacaine HCl versus bupivacaine HCl alone for Interscalene brachial plexus block in patients having major shoulder surgery. Reg Anesth Pain Med., 2017; 42(3): 334–41.
8. An K, Elkassabany NM, Liu J. Dexamethasone as adjuvant to bupivacaine prolongs the duration of thermal antinociception and prevents bupivacaine-induced rebound hyperalgesia via regional mechanism in a mouse sciatic nerve block model. PLoS One, 2015; 10(4): e0123459.
9. Gordon SM, Chuang BP, Wang XM, et al. The differential effects of bupivacaine and lidocaine on prostaglandin E2 release, cyclooxygenase gene expression and pain in a clinical pain model. Anesth Analg, 2008; 106(1): 321–7. table of contents.
10. Eker HE, Cok OY, Aribogan A, et al. Management of neuropathic pain with methylprednisolone at the site of nerve injury. Pain Med., 2012; 13(3): 443–51.
11. Williams BA, Ibinson JW, Mangione MP, et al. Research priorities regarding multimodal peripheral nerve blocks for postoperative analgesia and anesthesia based on hospital quality data extracted from over 1,300 cases (2011-2014). Pain Med., 2015; 16(1): 7–12.
12. Albrecht E, Kern C, Kirkham KR. A systematic review and meta-analysis of perineural dexamethasone for peripheral nerve blocks. Anaesthesia, 2015; 70(1): 71–83.
13. Kirkham KR, Jacot-Guillarmod A, Albrecht E. Optimal dose of perineural dexamethasone to prolong analgesia after brachial plexus blockade: a systematic review and meta-analysis. Anesth Analg, 2018; 126(1): 270–9.
14. Chong MA, Berbenetz NM, Lin C, Singh S. Perineural versus intravenous dexamethasone as an adjuvant for peripheral nerve blocks: a systematic review and meta-analysis. Reg Anesth Pain Med., 2017; 42(3): 319–26.
15. Baeriswyl M, Kirkham KR, Jacot-Guillarmod A, et al. Efficacy of perineural vs systemic

dexamethasone to prolong analgesia after peripheral nerve block: a systematic review and meta-analysis. Br J Anaesth, 2017; 119(2): 183–91.