INCIDENCE OF HEMIDIAPHRAGMATIC PARALYSIS WITH PATIENT CONTROLLED INFUSION OF LOW VOLUME OF ROPIVACAINE AFTER USG GUIDED LOW DOSE INTERSCALENE BRACHIAL PLEXUS BLOCK, A PROSPECTIVE OBSERVATIONAL STUDY

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INTRODUCTION:Diaphragmatic paresis due to phrenic nerve block is a side-effect of interscalene brachial plexus block (ISB).
•It is administered for anaesthesia and analgesia in patients with fractures of the humerus and injuries to the shoulder joint.
•USG guided ISB increase success rate and minimise complications.
•Continuous blocks are favoured over single shot to minimise supplemental opioid requirements, improves sleep quality and increases patient satisfaction

AIM-To assess the incidence of hemidiaphragmatic paralysis in patients administered low dose patient controlled interscalene analgesia (2ml/hr of 0.2% ropivacaine) after USG guided low dose bolus injection of 10 ml of 0.5% ropivacaine.

MATERIALS AND METHODS

- Approved by ethics and registered on clinicaltrials.gov (NCT03081728)
- Prospective, randomised, observational study (2016-2017)
- Inclusion criteria:** Patients aged 18-65 years belonging to ASA PS I-III with either fractures of proximal humerus or shoulder dislocations
- Exclusion criteria:** Patient's refusal for block, allergy to amide local anaesthetic, inability to operate PCA and interpret VAS, coagulopathy, severe respiratory disease (FEV₁/FVC <0.7 and FEV₁ < 80% of predicted), infection at the block site, prior history of neck surgery or radiation to the neck, neurological deficit in the arm or suspicion of nerve injury, patients with polytrauma or head injury (GCS<15) and chronic opioid abusers
- Non-random allocation based on the post-operative analgesic modality employed:
- Group I: Patient controlled interscalene analgesia (PCIA)**
- Group II: Multimodal analgesia (MA)**-Acetaminophen (1 gm) and diclofenac 75 gm (rescue tramadol) was administered.
- Pre-procedural ultrasound scanning:**To measure diaphragmatic excursion
- General Anesthesia Protocol:** Propofol, morphine, vecuronium for induction. O₂/N₂O/Isflurane (1 MAC) for maintenance of anaesthesia
- Assessment of pain:** No intervention was done for patients with VAS<3. VAS >3
- *Patients in Group I (PCIA) administered 10ml of 1% lignocaine
- *Patients in Group II administered fentanyl bolus dose of 0.5µg/kg. VAS re- assessed after 20 minutes and if VAS >3
- *Patients in Group I managed with 2nd dose of 10ml of 1% lignocaine
- *Patients in Group II administered a second fentanyl bolus dose 0.5µg/kg. The patients were monitored for the first 24 hours

RESULTS: Incidence of complete and partial paresis of diaphragm after extubation was 85%and 3.7%. Mean value of diaphragmatic excursion was 1.5±0.8cm (1-1.9cm) in patients with paresis

RESULTS (contd...)

- Single PCA bolus dose administered by 13 patients (48%) in the first 6 hours
- Two bolus doses/hour administered by 2 patients in first 6 hours and only one patient took two bolus doses/hour in the next 6 hours.
- Partial paresis in all the six instances in which two bolus doses/hour administered but diaphragmatic excursion normalized in the next recording made at 3 hours. No paresis in patients administered background infusion/single bolus doses of ropivacaine and scanned at 30 minutes after bolus and at 4, 6,12 and 24 hrs.
- No episodes of vomiting, respiratory discomfort, Horner's syndrome pneumothorax, LAST or intravascular injections

Comparative evaluation of VAS Score			
Values (Mean±SD)	PCIA	MA	p value
T(0) VAS at Extubation	0.7±1.2	4.4±1.9	0.01
6 hours a) Worst VAS	2.4±0.9	4.4±1.9	0.00
b) Avg VAS	1.2±0.5	2.0±1.0	0.03
c) Best VAS	0.2±0.5	0.6±0.8	0.03
12 hours a) Worst VA	2.8±1.2	3.8±1.2	0.06
b) Avg	1.5±0.7	1.8±0.8	0.09
c) Best	0.3±0.6	1.0±0.8	0.02
24 hours a) Worst	2.6±1.4	3.8±1.5	0.04
b) Avg	1.3±0.6	1.8±0.8	0.01
c) Best	0.2±0.6	0.7±0.8	0.04

The analgesic effectiveness of PCIA			
Patient Satisfaction Score	PCIA (Mean ±SD)	MA (Mean ±SD)	p value
Extubation (T0)	4.0±0.67	3.2±0.91	0.02
6 hr	3.5±0.93	2.9±0.80	0.16
12 hr	3.5±0.93	2.9±0.87	0.20
24 hr	4.0±0.67	3.2±0.91	0.02

DISCUSSION: Single shot ISB impair pulmonary function and continuous infusions have not been used by clinicians with the hypothesis that continuous ISB would prolong pulmonary dysfunction.3.6 ml is the minimum effective volume of local anaesthetic (0.75% ropivacaine) for shoulder analgesia in 95% patients using US-guidance at the C7 root level. This dose does not lead to hemidaipahragmatic paralysis as measured by USG.Limitations of our study were that blinding and randomisation was not done as only the eligible patients were allocated the block group.Comparision of diaghrgmatic excursion in controls was not done. In this study the potential for inter observer variability in distance measurements using on-screen caliper tool was not excluded as evaluation of the reproducibility of these measurements was not done. Moreover results of this study relate only to ISB performed for analgesic purposes and may not apply for surgical analgesia.

CONCLUSION:Ultrasound guided interscalene brachial plexus block at C6-C7 root using 10ml of 0.5% ropivacaine causes diaphragmatic paresis in 85% patients, with no clinical implications. Continuous infusion of ropivacaine 0.2% at 2ml/hr with on demand 5ml boluses administered via an ultrasound-guided C6-C7 root/superior trunk perineural catheter produces effective analgesia and high Patient Satisfaction Score and no hemidiaphragmatic paralysis.

REFERENCES

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Figure: Study Flow Diagram

Insertion of catheter prior to extubation.
Performed with a 38 mm broadband linear array high frequency transducer at the level of the cricoid cartilage to visualize C5, C6 and C7 nerve roots
18G epidural needle inserted using in plane technique.
Needle tip positioned between the upper trunk and C7 nerve root next to the hyperechoic layer of the plexus (perplexus).
After negative aspiration bolus of 3-5 ml of saline injected.
A non-stimulating multi-orifice catheter advanced past the needle tip such that 5-6 cm remained distal to the needle tip position.
The catheter tunnelled subcutaneously and 10 ml of 0.5% ropivacaine administered

USG guided ISB (USISB) for PCIA

Low frequency curvilinear (2-5 MHz) transducer in anterior subcostal space with the liver/spleen as an acoustic window and the hemi diaphragm as a hyperechoic line.

Complete paralysis : either of the one
- <75% of diaphragmatic movement
- No movement
-Paradoxical movement.
Partial paralysis- 25%-75% reduction
No paresis- only 25% reduction

The ipsilateral & contralateral hemidiaphragmatic excursion was measured from M-mode sonography with patients in supine position

S.no.	Demographic variable	PCIA(n=27)	MA(n=27)	p value
1	Age(years)	35.1±11.4	40.8±13.1	0.09
2	Weight(kg)	65.3±8.1	59.4±8.1	0.01
3	Height(cm)	158.7±7.7	158.0±7.4	0.80
4	BMI(kg/m ²)	26.7±2.8	24.1±2.6	0.01
5	Sex (F:M)	8:19	11:16	0.56
6	ASA 1/2/3	22/4/1	18/9/0	
7.	Baseline vital parameters			
	HR(beats/min)	87.1±10.5	75.5±11.9	0.81
	MAP(mm Hg)	79.1±11.4	73.4±7.6	0.37
	SPO2(%)	99.5±0.50	99.3±0.55	0.13
	RR(breaths/min)	14.6±1.6	15±1.2	0.26
8.	Comorbid conditions			0.09
	HTN	2(7.4%)	4(14.8%)	
	HTN and DM	0(0%)	4(14.8%)	
	SIEZURES	1(3.7%)	1(3.7%)	
	BA	1(3.7%)	0(0%)	
	CAD	1(3.7%)	0(0%)	
9.	Diagnosis:			
	a) Proximal humerus fracture	24(88.9%)	24(88.9%)	NS
	b) Shoulder Dislocation	3(11.1%)	3(11.1%)	
10.	Surgery:			
	a) PHILOS	24(88.9%)	24(88.9%)	NS
	b) Hemiarthroplasty	3(11.1%)	3(11.1%)	
11	*Duration of surgery(mins)	271.1±39.4	276±34.7	0.61
12	*Duration of anaesthesia(mins)	302.8±42.8	300.3±34.2	0.81

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