RESULTS

Comprehensive Literature Search

Our search strategy identified 73 studies. The titles and abstracts of 382 studies were screened for eligibility. After removing duplicates, irrelevant studies, animal studies, and non-English articles (n=141), 241 full-text articles were assessed for eligibility. After reading the full text of these studies, more studies (n=168) were excluded as they were non-RCTs and conducted among children. The remaining 73 RCTs were included in this systematic review. The flow chart of the study inclusion process is shown in [Figure 1].

Description of the Included Studies (n=73)

The study characteristics involving the year of publication, ASA status, clinical setting, number of patients, and the duration of follow-up assessment are shown in [Table 1].

(a) **Year of publication**

A total of 73 studies were included in the systematic review. Majority of the studies were published in the year 2018 (n=10), followed by 2019 (n=9), and 2015 (n=8). The year distribution of the studies is as follows: 2001 (n=1),[6] 2003 (n=3),[7,8,9] 2005 (n=4),[10,11,12,13] 2006 (n=1),[14] 2007 (n=1),[15] 2008 (n=4),[16,17,18,19] 2009 (n=4),[20,21,22,23] 2010 (n=3),[24,25,26] 2011 (n=4),[27,28,29,30] 2012 (n=2)[31,32] 2013 (n=1),[33] 2014 (n=2),[34,35] 2015 (n=8),[36,37,38,39,40,41,42,43] 2016 (n=6),[44,45,46,47,48,49] 2017 (n=3),[50,51,52] 2018 (n=10),[53,54,55,56,57,58,59,60,61,62] 2019 (n=9),[63,64,65,66,67,68,69,70,71] and 2020 (n=7),.[72,73,74,75,76,77,78]

(b) Number of patients

The 73 studies involving a total of 5819 patients were included in the present systematic review.

(c) ASA status 2.2.12

Almost all the studies have given the ASA status of the patients. A total of 27 studies have included patients till ASA III,[6,8,15,16,19,21,23,24,25,29,33,34,35,36,38,44,45,46,47,50,51,52,54,55,56,57,58,67,74] and 29 studies have included patients till ASA II.[7,11,14,18,22,28,31,37,40,42,53,56,59,60,61,62,63,64,65,66,68,69,70,71,72,75,76,77,78] Mean ASA was given in three studies,[17,27,39] and one study was conducted among healthy volunteers.[73]

(d) Duration of follow-up:

At 15 minutes, post-block assessment interval was done in two studies,[30,32] at 30 min, post-block assessment was done in 25 studies.[7,12,13,14,15,19,20,26,35,43,44,45,50,51,52,53,62,64,69,70,71,74,75,76,77]Within 24 hrs, post-block assessment was done in 14 studies,[16,20,33,37,42,49,56,59,60,61,63,66,68,78] and more than 24 hrs post-block assessment was done in rest of the 32 studies.[Table 1]

(e)Type of block drug used and additional use of drugs

Seventeen studies have used combination of two or three block drugs.[14,20,26,27,34,35,37,40,42,46,53,54,55,64,67,74,75] Rest of the studies (n=56) have used one of the following LA drug (bupivacaine, ropivaciane, lidocaine, mepivacaine).A total of 22 studies have use epinephrine as vasoconstrictor.[11,14,15,17,19,20,23,27,29,32,35,36-38,41,44,45,53,54,57,64,73]Additional use ofclonidine,[70] MgSO4,[62,66,68] fentanyl,[56,60,77]dexamethasone,[25,54,76,78] and dexmedetomidine,[55,56,59,60,62,70,75,76,77] were done in several studies [Table 2].

(f)Technique of LA injection

A total of 30 studies,[6,7,8,10,12,13,16,19,21,24,29,30,32-34,36-38,41,42,43,44,49,50,53,68-70,72,78] have used the single technique of LA injection, five studies,[7,11,19,35,71] have used both single and multiple injection techniques, and in rest of them (n=58), multiple injection technique was used [Table 2].

(g)Approach used in studies

A total of 21 studies were based on SBPB approach,[6,22,25,29,35,39,41,42,53,56,59,60,61,66,68,70,71,75,76,77,78]15 studies were based on ISBPB approach,[14,16,21,27,28,30,31,33,38,44,48,49,51,65,72] seven studies depicted the AXB approach,[8,9,11,15,26,32,34] and six studies were based on IBPB approach .[17,19,52,54,62,73]

Rest 24 studies have shown the comparison of two approaches. Comparison of ISBPB and SBPB approaches was done in eight studies,[40,43,46,47,50,57,63,70] ISBPB and AXB in one study,[13] ISBPB, SBPB, and IBPB in one study,[37] AXB and IBPB in three studies,[7,10,12] SBPB, IBPB and AXB in two studies,[23,45] SBPB and IBPB in four studies,[18,20,24,36] IBPB and RBPB in one study,[67] SBPB and CBPB in two studies,[64,74] ISBPB, SBPB and suprascapular in one study,[59]and in one study, name of the BPB,[55] is not given [Table 3].

(h)Technique of block needle insertion

A total of 40 studies,[16,17,19,20,22,23,25,27,28,29,30,31,32,36,37,38,39,40,41,43,44,45,47,48,49,50,51,52,53,54,55,56,57,58,60,61,67,71,72,76] have used the in-plane technique of block needle insertion, both in and out-plane techniques were used in two studies.[18,46] In one of the study, either In-plane or out-plane technique was used,[64] depending on the operator, and in rest of the studies (n=30), they have not

clearly mentioned [Table 3].

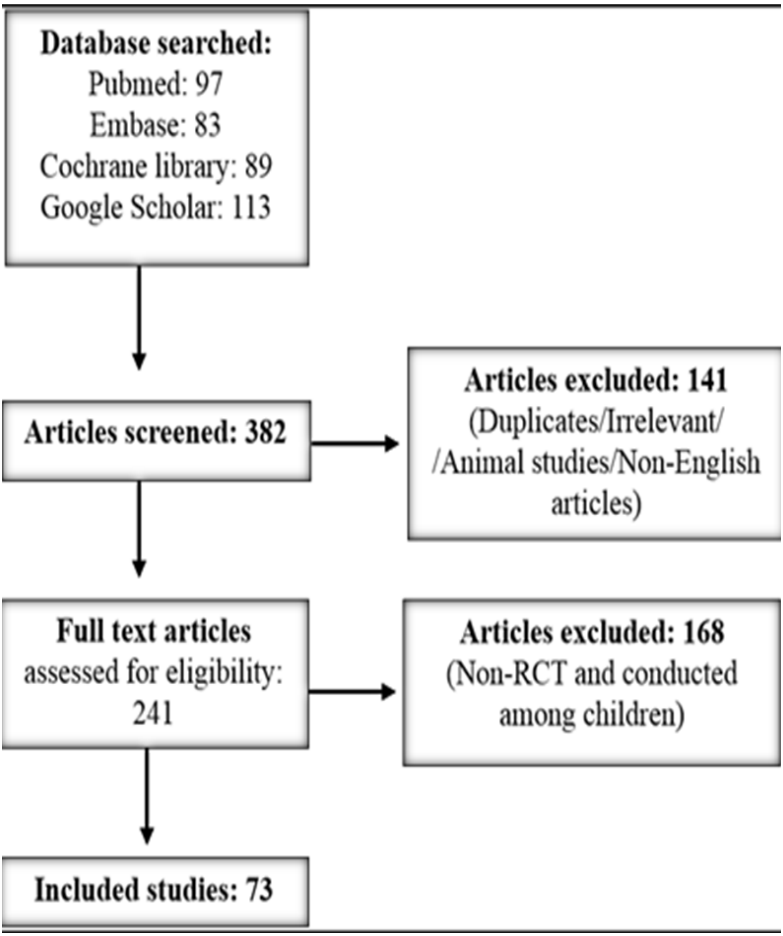

Figure 1: The flow chart of the study inclusion process

Table 1: Showing the characteristics of the included studies (n=73)

Study	Number of patients	ASA (I/II/III)	Clinical setting	Follow-up assessment
Mak PHK et al (2001),[6]	30	I/II/III	Upper limb surgery	10 min
Deleuze A et al (2003),[7]	100	I and II	Arthroscopic shoulder surgery	5, 10, 15, 20, 25, and 30 minutes
Serradell A et al (2003),[8]	114 (38/38/38-36ml/28ml/20 ml group)	17/16/5 (36 ml group) 12/18/8 (28 ml group) 12/18/8 (20 ml group)	Elective distal upper limb surgery	40, 50 and 60 min
March X et al (2003),[9]	100		Elbow/ forearm/ wrist/hand: 9/2/10/28 (Group A) and 4/5/8/30 (Group H)	40 min
Rettig HC et al (2005),[10]	60 (Axillary-30 and IBPB-60)		Upper arm-proximal/ distal/wrist or hand/other: 13/5/9/3(IBPB), 7/4/17/2 (axillary)	5, 10, 15, 20, 30 and 60 min

Liu FC et al (2005),[11]	90 (nerve stimulator-guided and double-injection (ND) group-30), US-guided and double-injection (UD) group-30), and US-guided and single-injection (US) group-30	I/II	Elective surgery of the hand, wrist, or forearm	40 min
Heid FM et al (2005),[12]	60	-	Upper limb surgery distal to the elbow	30 min
Soeding PF et al (2005),[13]	40	-	Upper Limb Surgery	10 and 30 min
Pippa P et al (2006),[14]	60	I/II	Shoulder capsuloplasty	30 min
Chan VWS et al (2007),[15]	NS-62 US-64 USNS-62	I/II/III	Elective hand surgery	30 min
Riazi S et al (2008),[16]	60 40 (group I-20 and group II-20)	7/12/1 (group I) 5/12/3 (group II)	Shoulder surgery	30 min, 60 min, 120 min, 12 hrs and 24 hrs
Dhir and Ganapathy,[17] (2008)	66 (TR-22, ST-22, US-22)	1.8±0.7 (TR) 2.2±0.5 (ST) 2±0.(US)	Elective hand surgery	3 weeks
De Jose Maria B et al (2008),[18]	80 (SBPB-40 and IBPB-40)	I/II 29/11 (group I) 28/11 (group S)		1 week
Tran DQH et al (2009),[19]	88 (single injection-44, double injection-44)	I/II/III 39/5/0-single injection 36/6/2-double injection	Upper limb surgery	5,10,15, 20, 25, 30 min

Koscielniak-Nielsen JZ et al (2009),[20]	120 (Group I-60 and group II-60)		Upper extremity surgery	20 and 30 min
Renes SH et al (2009),[21]	30	I/II/III 3/11/1 (US-ISB) 4/11/0 (NS-ISB)	Elective shoulder surgery	5, 10, 15, 30, 180, and 360 minutes after ISB
Renes SH et al (2009),[22]	60	I/II 13/17 (US) 10/20 (NS)	Elective elbow, forearm, wrist, or hand surgery	5, 10, 15, 30, 180, and 360 min
Tran DQH et al (2009),[23]	120 SBPB (n = 40), IBPB (n = 40), or AXB (n = 40)	I/II/III: 28/10/2 (SBPB) 29/10/1 (IBPB) 26/13/1 (AXB)	Upper extremity surgery of the elbow, forearm, wrist, and hand	
Yang CW et al (2010),[24]	100 (group S-50 and group I-50)	I/II/III: 28/20/2 (group S), 30/20/0 (group I)	Upper limb surgery-Hand/wrist/ forearm/elbow: 16/4/23/8 (SBPB), 20/4/17/9 (IBPB)	-
Parrington SJ et al (2010),[25]	45 (normal saline group-21) (dexamethasone group-24)	I/II/III 6/12/3 (normal saline group) 12/11/1 (dexamethasone group)	Elective hand or forearm surgery Elbow/ forearm/ hand: 0/4/17 (Group 2), 1/2/21 (Group 1)	1, 7 and 14 days
Gianesello L et al (2010),[26]	100	-	Upper limb surgery	30 min
Thomas LC et al (2011),[27]	41 (US group-22) (NS group-19)	2 6±0.5 (US group) 2 6±0.4 (NS group)	Orthopedic shoulder surgery	2 weeks

Lee JH et al (2011),[28]	60 (group-30) (group 10-30)	I/II 13/17 (group 5) 17/13 (group 10)	Arthroscopic rotator cuff repair surgery	30 min, 12 hrs, 24 hrs and 48 hrs

Subramanyam R et al (2011),[29]	72 (lateral approach-35) (medial approach-37)	I/II/III 18/15/2 (lateral approach) 18/16/3 (medial approach)	Hand or wrist: 34 (lateral), 32 (medial) Forearm: 0 (lateral), 5 (medial) Elbow: 1(lateral), 0(medial)	7 days
Sinha SK et al (2011),[30]	30	-	Arthroscopic shoulder surgery	15 min
Behr A et al (2012),[31]	150 (control-50, IMB-50, EMB-50)	I/II-35/15 (control), 38/12 (IMB), 31/1 (ENB)	Arthroscopic surgery	2, 4, 6, 8, 12, 24, and 36 h
Bernucc F et al (2012),[32]	50 PV(n = 25) or PN (n = 25)	-	Upper extremity surgery	10 and 15 min
Kaya M et al (2013),[33]	60 (group 1-30, group 2-30)	I/II/II-10/19/1 (group 1), 13/14/ group 2)	Modified radical mastectomy	24 hrs
Saracoglu S et al (2014),[34]	60	I/II/III	Hand or forearm surgery	90 min
Arab SA et al (2014),[35]	96	I/II/III	Arteriovenous fistula creation or superficialization	20 min and 30min
Yazer MS et al (2015),[36]	64 (SBPB-32, IBPB-32)	I/II/III-15/15/2 (SBPB), 20/10/2 (IBPB)	Hand/wrist/ forearm/elbow: 14/12/2/4 (SBPB) and 13/12/4/3 (TII-IBPB)	30 min and 1 week

Bharti N et al (2015),[37]	60 (SBPB-21, IBPB-20, ISBPB-19)	I:II- 16:4 (SBPB group), 19:1 (IBPB group), 18:2 (ISBPB group)	Upper limb surgery	30 min and 24hrs
Bjørnholdt KT et al (2015),[38]	61 (LIA group-30, ISBPB-31)	I/II/III-5/20/5 (LIA group) 4/23/4 (ISBPB)	Shoulder replacement surgery	24 hrs and 3 days
Singh S et al (2015),[39]	102	Mean ASA: 1.28±0.45 (US),1.21±0.41 (NS)	Upper limb surgery	30 min
Ryu T et al (2015),[40]	ISBPB-47; SBPB group-46	I/II-25/22 (ISBPB), 27/19 (SBPB)	Arthroscopic Shoulder Surgery	20 min
Liu GY et al (2015),[41]	60	-	Distal upper limb surgery	
Kooloth RA et al (2015),[42]	60	I/II	Upper limb surgery	30, 45 min, 1 hr and 24 hours
Petrar SD et al (2015),[43]	64	-	Right-sided upper arm surgery	30 min
Palhais A et al (2016),[44]	40 (20 in each group)	I/II/III-6/12/2 (conventional injection), 13/6/1 (extrafascial injection)	Upper limb surgery	30 min
Stav A et al (2016),[45]	101 (SBPB-37, IBPB-23, AXB-34)	I/II/III-7/1/29 (SBPB), 4/4/15 (IBPB), 6/3/25 (AXB)	Upper limb surgery	30min
Wiesmann T et al (2016),[46]	120	I/II/III	Elective arthroscopic shoulder surgery	1 week
Koh WU et al (2016),[47]	Continuous interscalene (n = 38) or supraclavicular block (n = 37)	I/II/III	Open rotator cuff surgery	30 minutes, 1 hour and 14 hours

Ghodki and Singh (2016),[48]	60 ((NS-30 and US-30 patients)	-	Shoulder arthroscopy	5, 10, 15, 20 min and 1 day (for HDP)
Stundner O et al (2016),[49]	30	-	Shoulder surgery	24 hrs
Kim BG et al (2017),[50]	49 ISBPB-25 SBPB-24	I/II/III-13/10/2 (group I), 15/6/3 (group S)	Shoulder surgery	30min
Albrecht E et al (2017),[51]	70 (intrafascial-35,extrafascial group-35)	I/II/III- 15/8/11 (intrafascial group), 18/1/15 (extrafascial group)	Elective major shoulder surgery	30 min, 1 and 2 days
Oztur NK et al (2017),[52]	100 (group R-50, group C-50)	I/II/III-26/20/4 (group R), 23/18/9 (group C)	Upper limb surgery	30 min
Kang RA et al (2018),[53]	36 (CP group-18, NC-18 group)	I/II-14/4 (CP group), 16/2 (NC group)	Upper limb surgery	10 min and 30min
Bravo D et al (2018),[54]	360 (2mg-119, 5mg-120, 8mg-120)	I/II/III- 65/50/4 (2mg), 66/52/2 (5mg), 60/56/4 (8mg)	Upper extremity surgery (hand/ wrist/forearm/ elbow- 2mg-48/46/17/8, 4mg-65/33/17/5, 8mg-56/36/21/7	1 and 2 weeks
Hong B et al (2018),[55]	102	I/II/III	Upper limb surgery	
Hamed MA et al (2018),[56]	60 (20 in each group)	I/II-18/2 (group D), 17/3 (group F), 17/3 (group C)	Orthopaedic surge	24 hrs
Aliste J et al (2018),[57]	44	I/II/III 3/10/0 (ISB) 8/14/0 (SBPB)	Arthroscopic shoulder surgery	6,12 and 24 hrs

Auyong DB et al (2018),[58]	189	I/II/III 16/41/6 (ISBPB) 11/50/2 (SBPB) 13/47/3(Suprascapuar)	Arthroscopic shoulder surgery	24hrs
Sinha C et al (2018),[59]	90	I/II 35/10 (Group I) 31/14 (Group II)	Forearm/hand: 25/20(Group I), 22/23 (Group II)	48 hrs
Dharmarao PS et al (2018),[60]	80	I/II	Elective upper limb surgeries	24hrs
Mangal V et al (2018),[61]	90	I/II	Elective upper limb surgeries	150 min
Elyazed MAM et al (2018),[62]	105	I/II	Hands, wrist, and forearm surgery	30 min
Karaman Tet al (2019),[63]	62	I/II 14/17 (ISBPB) 16/13 (SBPB)	Upper limb surgery	24hrs
Sivashanmugam T et al (2019),[64]	40 (SBPB-20, Costoclavicular-20)	I/II 13/7 (SBPB), 11/9 (costoclavicular)	Right-sided upper extremity surgery.	30 min
Ayyanagouda B et al (2019),[65]	60 (extrafascial-30, intrafascial-30)	I/II-20/9 (extrafascial), 16/14 (intrafascial)	Proximal upper limb surgeries	-
Kaur S et al (2019),[66]	105 (Group 1=34), (Group II-34), (Group III-31)	I/II 25/10 (group I), 17/18 (group II), 27/8 (group III)	Elective upper limb surgery (forearm and hand)	8hrs, 12 hrs and 24 hrs
Blanco AFG et al (2019),[67]	109 (RBPB-53, IBPB-56)	I/II/III-27/24/2 (RBPB), 22/25/9 (IBPB)	Upper extremity surgery	48 hrs
Elhusein AKA et al (2019),[68]	40 (Group I-20) (Group II-20)	I/II	Elective upper limb surgery	24 hrs

Singh and Singham (2019),[69]	60	I/II 20/10 (ISBPB) 19/11 (SBPB)	Elective and emergency shoulder surgeries	30min
Singh and Singham (2019),[70]	90	I/II 22/8 (CL) 23/7 (CD) 23/7 (DX)	Upper extremity surgeries	30 min
Refaat S et al (2019),[71]	36	I/II	Upper extremity surgeries	30 min
Patel MA et al (2020),[72]	155 (LB 133mg, N=69; LB 266mg, N=15; placebo, N=71).	I/II/III- 15/36/18 (LB 133mg), 14/37/20 (placebo)	Total shoulder arthroplasty or rotator cuff repair	Through 120 hrs, 7th day and 14th day
Kasine T et al (2020),[73]	26	-	Healthy patients	3 weeks
Luo Q et al (2020),[74]	112	I/II/III (SBPB-49.1%, 41.8%, 9.1%) (CBPB-45.5%, 43.6%, 10.9%)	Upper limb surgery	30 min
Sachdev S et al (2020),[75]	60	I/II	Upper limb surgeries	30
Singh N et al (2020),[76]	60	I/II	Elective upper-limb surgery	50
Lotfy ME et al (2020),[77]	90	I/II	Upper limb surgeries	30
Youssef MY et al (2020),[78]	120 (30 in each group)	I/II	Upper limb surgeries	24 hrs

Table 2: Showing the characteristics of the block drug and its related complications (n=73)

Study	Block drug	Technique of local anesthetic injection	Onset time and duration of block	Complications related to local anesthetic toxicity
Mak PHK et al (2001),[6]	Bupivacaine 0.375% 0.5 ml. kg^{-1}	Single	-	-
Deleuze A et al (2003),[7]	40 ml of ropivacaine 0.75% Volume: 5 ml	Single-IBPB Triple-Axillary	Onset of sensory and motor block: 6 ±2 and 17.5 ±3 (axillary) 17±9 and 21±8 (SBPB) Block performance time: 2.5±1.9 min (IBPB) , 6.0±2.8 min (AXB)	Axillary artery and axillary vein puncture: 1 patient (IBPB)
Serradell A et al (2003),[8]	Group 1: 36 (n=38) ml Group II: 28 (n=38) ml Group III: 20 ml (n=38) of mepivacaine 10 mg ml±1	Single	Mean duration of analgesia/ Mean block performance time, min : 246.2 and 7.6 (36 ml group), 244.7 and 6.6 (28 ml group), 230.9 and 6.1(20 ml group)	Venous puncture: 6 (36 ml group), 6 (28 ml group), 7 (20 ml group),

March X et al (2003),[9]	40 ml mepivacaine of 1%	Multiple	Onset time / Block performance time (min): 16 ±8 and 8±4 (Group A), 21 ±9 and 11±4 (Group H) Total anesthetic time (min): 24 ±8 (Group A), 33 ±10 (Group H)	Vascular puncture (%): 22 (Group A), 8 (Group H) (P<0.05)
Rettig HC et al (2005),[10]	Ropivacaine 7.5 mg/ml, at a dose of 0.5 ml/kg (3.75 mg/kg)	Single	Block procedure time (min): 9.2 (IBPB) and 5.3 (axillary)	PONV/blood aspiration: 1/8 patients (IBPB) and nil/6 patients (axillary)
Liu FC et al (2005),[11]	0.5 ml kg-1 of 1.5% lidocaine with 5 µg kg-1 epinephrine	Double injection (ND and UD groups) Single (US group)	Duration of block performed (min): 8.2 ± 1.5 (ND), 6.7 ± 1.3 (UD), 6.5 ± 1 (US) Duration of operation (min): 45.7 ± 12.1 (ND), 46.3±11.5 (UD), 48.7 ± 12.8 (US)	Tourniquet pain/vessels puncture/ hematoma: 7%/10%/3% (ND), 3%/0%/0% (UD), 7%/0%/0% (US)
Heid FM et al (2005),[12]	40ml ropivacaine 0.75% (300mg)	Single	80% of the vertical IBPB patients showed a complete sensory block in the radial nerve area, compared to 36.7% of the HAP	Accidental venous puncture: 1 patient (both groups)

Soeding PF et al (2005),[13]	Ropivacaine (0.75% solution for interscalene block, and 0.6% for axillary block Dose- 3 mg/kg	Single	Duration of block: 10.3±0.6 (control) and 11.2±0.6 (US-guided)	-
Pippa P et al (2006),[14]	Group I: 60ml of bupivacaine 0.25% (with 150µg epinephrine, i.e. 2.5µgml^{-1}) and lidocaine 1% Group II: 30ml of bupivacaine 0.50% (with 150µg epinephrine, i.e. 5µgml^{-1}) and lidocaine 2%.	Multiple	Motor block: 25 min and 15 min in Groups I and II, respectively ($P<0.05$).	Dysphonia: 20 patient
Chan VWS et al (2007),[15]	2% lidocaine with 1:200,000 epinephrine and 0.5% bupivacaine (total 42 ml),	Multiple	The block procedure time: 9.3 ± 4.0 min (group US) vs 11.2 ± 4.4 min (Group NS), and 12.4 ± 4.8 min (Group USNS) ($P = 0.01$)	Local bruising/ pain: 8 patients/10 patients (NS), 2/3 patients (US), 0/3 patients (USNS)
Riazi S et al (2008),[16]	ISBPB of either 5 ml (low volume-group I) or 20ml of ropivacaine 0.5% (standard volume-group II)	Single	-	

Dhir and Ganapathy (2008), [17]	40 millilitres of 15mg/ml mepivacaine with 2.5mg/ml adrenaline Group TR: LA injected with needle' Group ST-catheter; Group US- LS was observed ultrasonographically	Multiple	Total motor block in all nerves after 20min (out of 10): 4.8±2.9 (TR), 6.3±2.2 (ST), 6.8±2 (US). Time to achieve complete motor and sensory block (min) 28.1±8.8 (TR), 23.9±8.7 (ST), 21.1 ±7.8 (US)	-
De Jose Maria B et al (2008), [18]	GA with 8% sevoflurane Block with ropivacaine 0.5%, up to a maximum volume of 0.5 ml/kg)$^{-1}$ Volume of ropivacaine 6 ± 2 ml	Multiple	Mean time: 13 min in IBPB and 9 min in SBPB. The duration of the sensory block was 6.5 ± 2 h and of the motor block was 4 ± 1 h.	Accidental puncture o-f the axillary artery-2 patients (IBPB)
Tran DQH et al (2009), [19]	Single-injection (n = 44) or double-injection (n = 44) 3 ml xylocaine 1% and 35 milliliters of lidocaine 1.5% with epinephrine 5 Kg/ml	Single and double	Onset time, mean, min: 19.4 (single), 19.3 (double) Total anesthesia-related time, mean, min: 24.5 (single), 24.7 (double) Performance time, mean, min 5.1 (single) 5.8 (double)	-

Koscielniak-Nielsen JZ et al (2009),[20]	Equal volumes of ropivacaine 7.5mg/ml and mepivacaine 20 mg/ml with adrenaline 5mg/ml	Multiple	Block performance time (min): 5.0±1.6 (IBPB) and 5.7± 1.6 (SBPB)	Vessel puncture: 1 patient (IBPB) and 1 patient (SBPB)
Renes SH et al (2009),[21]	10 ml of ropivacaine 0.75%	Single	Onset time: 30 min	-
Renes SH et al (2009),[22]	20 ml of 0.75% ropivacaine	Multiple	-	-
Tran DQH et al (2009),[23]	35 ml lidocaine 1.5% with epinephrine 5 Kg/ml (IBPB) 7ml lidocaine 1.5% with epinephrine 5 Kg/ml (AXB) 35ml lidocaine 1.5% with epinephrine 5 Kg/ml (SBPB)	Single	Mean onset time: 18.2min (SBPB), 18.5 min (IBPB), 17.8 min (AXB) Total anesthesia-related time: 23.1 min (SBPB), 23.9 (IBPB), 25.5 min (AXB)	Vascular puncture: 1 (2.5) (SBPB), 1 (2.5) (IBPB), 1 (2.5) (AXB)
Yang CW et al (2010),[24]	30 ml 0.5% ropivacaine	Single	Duration of sensory block: 763±202 (SBPB), 827±175 (IBPB) Duration of motor block: 774±231 (SBPB), 828±210 (IBPB)	Vascular puncture: 8 patients (SBPB), 7 (IBPB)
Parrington SJ et al (2010),[25]	Group 1: 30 ml mepivacaine 1.5% plus 2 ml normal saline. Group 2: 30 ml mepivacaine 1.5% plus dexamethasone 8 mg (4 mg/ml),	Multiple	Median duration of analgesia: 332 mins (Group 2), 228 mins (Group 1) (P = 0.008)	Nausea on POD 1/ vomiting at POD 7/ bruising at injection site POD 14: 10%/0/5% (Group 1), 5%/5%/6% (Group 2)

Gianesello L et al (2010),[26]	0.5% bupivacaine and 2% lidocaine (o.5ml/kg/body weight)	Multiple	Block performance time: Group I-9.8±2.3 and Group II-4±1.2	Venous puncture: 4 patients (Group I) and 6 patients (Group II)
Thomas LC et al (2011),[27]	20 ml of 1.5% mepivacaine and 20 ml of 0.75% ropivacaine, with 3 mg/ml epinephrine	Multiple	Mean duration of sensory and motor block: 19± 6.2 and 20.2±2.1minutes (NS group) and 12±6.2 and 13.5±2.3 minutes (US group) (P<.02 and P<0.03 respectively)	-
Lee JH et al (2011),[28]	5 (Group 5) or 10 ml (Group 10) of 0.75% ropivacaine	Multiple	Anesthesia time: 151 min (Group 5) and 150 mi (Group 10)	-
Subramanyam R et al (2011),[29]	30-ml local anesthetic admixture (1:1 lidocaine 2% bupivacaine 0.5% with 1:200,000 epinephrine)	Single	The rate of ulnar nerve sensory block at 20 mins: 63% in the lateral group and 62% in the medial group	Bruising/ pain: 26%/6% (lateral approach), 16%/14% (medial approach)
Sinha SK et al (2011),[30]	Either 10 (group I) or 20 ml (group II) of ropivacaine 0.5%	Single	Block performance time, mean ±SD, min: 777.1± 120.5 (group II), 744.9± 173.2 (group I)	-

Behr A et al (2012),[31]	29.5 ml of 0.75 % levobupivacaine Patients receive additionally either saline (control group) or intramuscular buprenorphine 0.15 mg (Group IMB) or epineural buprenorphine 0.15 mg (Group ENB)	Multiple	Duration of sensory block and postoperative analgesia: 856.1 ± 215.2 min and 1,049.7 ± 242.2 min (ENB group), 693.6 ± 143.4 and 820.3 ± 335.3 min (IMB group) or 488.3 ± 137.6 and 637.5 ± 72.1 min (saline)	Postoperative nausea and vomiting/ Artery puncture: 1/1 patient (control), 6/0 patients (INB group), 4/0 patients (EMB group)

Bernucc F et al (2012),[32]	Lidocaine 1.5% with epinephrine 5 Kg/ml (Total volume-32 ml)	Single	Total anesthesia-related time: 27.1 min (PV) and 29.0 min (PN) Performance time, min 8.2 (PV), 15.7 (PN) Onset time, min: 18.9 (PV), 13.8 (PN)	Vascular puncture: 6 patients (24%) (PV) and 0 (0%) (PN); (P = 0.01)
Kaya M et al (2013),[33]	30 ml bupivacaine 0.25 % Group 1: single-injection group 2: control group	Single	Duration of surgery (min) 187 ± 30 (group 1), 181 ± 34 (group 2)	Nausea/ vomiting/ antiemetic requirement: 47 %/43%/43% (Group 1), 83 %/57%/73% (Group 2) (P=0.03)
Saracoglu S et al (2014),[34]	70mg lidocaine followed by 150mg bupivacaine 0.5% in 10ml normal saline (total volume 40ml)	Single	Block performance time: 324.33±85.30 (pen+group) and 272.07±103.53 (pen-group) (p=0.01)	Arterial puncture/ venous puncture: 1/3 patients (pen+group), 1/7 patients (pen-group).

Arab SA et al (2014),[35]	Single injection group (SI): 10 ml of 1.5% lidocaine with epinephrine was injected incrementally, followed by another 20 ml of 0.5% ropivacaine. Triple injection group (TI): LA was injected in 3 aliquots of 10 ml each, each composed of 3.5 ml of 1.5% lidocaine with epinephrine and 6.5 ml of 0.5% ropivacaine	Single and triple	Sensory block of all 5 nerves was significantly better in the TI group (all P < 0.035). Successful surgical anesthesia: 40 patients (SI) and 46 patients (TI) Performance time ± SD (min): 4.67 ± 2.09 (SI), 6.51 ± 2.13 (TI)	Vascular puncture: 1 patient (SI) and 0 patient (TI)
Yazer MS et al (2015),[36]	Lidocaine 1.5% with epinephrine 5µg/ml IBPB-volume-35 ml TII-SBPB-half the volume (16ml)	Single	Onset time, min: 8.9 (SBPB), 17.6 (TII-IBPB) Total anesthesia-related time, min: 18.2 (SBPB), 22.8 (TII-IBPB) Performance time, min: 9.5 (2.9) (SPBP), 5.6 (2.3) (TII-IBPB)	-

Bharti N et al (2015),[37]	0.75% plain ropivacaine and 2% lignocaine-adrenaline (1:200,000) mixture as a single injection of 0.5 ml/kg	Single	Onset of motor block/ Block performance time, min: 16.5±7.9/ 5.2±1.4 (SBPB), 15.4±7.2/ 5.6±1.8 min (IBPB), 21.3±7.6/ 5.9±1.6 (ISBPB) Duration of analgesia: 641.2±68.3 min (SBPB), 654.2±88.5 (IBPB) min, 626.5±82.5min (ISBPB)	-
Bjørnholdt KT et al (2015),[38]	Group LIA: local infiltration analgesia -150 ml ropivacaine 0.2 % with epinephrine intra-operatively Group ISC: interscalene brachial plexus catheter-ropivacaine 0.75 %, 7 ml bolus followed by 48-h 5 ml/h infusion.	Single	-	dizziness, haematoma, sweating, stinging in the axilla, pain in axilla (n = 2), pin prick sensation in the forearm and thumb (n=1)

Singh S et al (2015),[39]	40 ml of 0.25% bupivacaine	Multiple	Mean duration of the block: 286.22 ± 42.339 (US), 204.37 ± 28.54 (NS) (p<0.05) The onset of block was faster in the Group US as compared to Group NS (P=0.007)	Accidental vascular punctures: 7 patients (NS), 1 (US) (P < 0.0001
Ryu T et al (2015),[40]	25 ml of LA containing 12.5mlof1%mepivacaine and 12.5 ml of 0.75% ropivacaine	Multiple	Onset time: 20-min Duration of anesthesia-705min in ISBPB and 733min in SBPB	
Liu GY et al (2015),[41]	40-ml bolus of mepivacaine, 1.5%, with epinephrine, 2.5 µg/ml,	Single	Onset time: 5.67 ± 2.58 (US-guided) and 16.97 ± 7.87 (NS)	Intravascular injection: 1 patient (NS group)

Kooloth RA et al (2015),[42]	Group R (Ropivacaine): 20 ml of 0.75% ropivacaine + 10 ml of normal saline (total volume 30 ml) Group B (Bupivacaine):30 ml of 0.5% bupivacaine.	Single	Mean onset time of motor blockade, min: 14.33+4.92 (Group R), 15.30+5.01 (Group B) Mean duration of motor blockade, min: 480.43±55.26 (Group R), 507.70±56.07 (Group B)	PONV: Group R-2 (6.67%), Group B-4(13.33%)
Petrar SD et al (2015),[43]	30 ml of 0.5% ropivacaine	Single	Sedation for block: 20 (63%) (SBPB), 23 (72%) (ISBPB)	-
Palhais A et al (2016),[44]	20 ml bupivacaine 0.5% with epinephrine 1:200000	Single	Onset time of motor and sensory blocks: 8 and 12 min (conventional) and 17 and 19 min (extrafascial) Duration of motor and sensory block: 1134 and 1026 min (conventional) and 980 and 922 min (extrafascial)	-

Stav A et al (2016),[45]	40 ml of bupivacaine 0.5% with adrenaline 1:200,000	Multiple	Duration: 25.35±9.65 min (AXB), 18.32±6.27 min (SBPB) and 19.48± 7.88 min (IBPB)
Wiesmann T et al (2016),[46]	10 ml of ropivacaine 0.2% followed by continuous application of 4 ml of ropivacaine 0.2%	Multiple	Onset time: 30min Block performance time, min: 7.2±4 (ISBPB) and 8.4±4 (SBPB)
Koh WU et al (2016),[47]	20 ml ropivacaine 0.375%	Multiple	Onset time: 30min Duration of anesthesia-164.7 min
Ghodki and Singh (2016),[48]	10 ml of 0.5% bupivacaine for both groups	Multiple	Sensory onset time/ Block performance time/block duration: 19 min/8 min/548.6 min (NS) and 12min/4.3 min/ 570.1min (US)
Stundner O et al (2016),[49]	Ropivacaine 0.75% (either 20 or 5ml) plus the contrast dye gadopentetate dimeglumine	Single	-
Kim BG et al (2017),[50]	20 ml of 0.375% ropivacaine	Single	Post-operative analgesia: 868 min (SBPB) and 800 min (ISBPB)
Albrecht E et al (2017),[51]	Ropivacaine 0.5% 20 ml through the catheter in 5 ml increments	Multiple	-

Oztur NK et al (2017),[52]	2–4 ml of 1% lidocaine 2 groups: a coracoid approach group (group C) and a retroclavicular approach group (group R)		Onset time, min/ Block performance time, min: : 15.4 ± 6/2.8 ± 1.6 (group R), 18.2 ± 5.1/6.2 ± 2.2 (Group C) Total anesthesia-related time, min: 17.9 ± 2.1 (Group R), 23.9 ± 2.2 (Group C)	Vascular puncture: 0 (Group R) and 1 patient (2%) (Group C)
Kang RA et al (2018),[53]	12.5 ml of 0.75% ropivacaine and 12.5 ml of 2% lidocaine with 1:200,000 epinephrine Group CP: LA was injected in corner pocket' Group NC: LA inserted inside the neural cluster	Single	-	-
Bravo D et al (2018),[54]	35 ml of lidocaine 1%-bupivacaine 0.25% with epinephrine 5 µg/ml Group I, II and III: 2, 5, or 8 mg of preservative-free perineural dexamethasone.	Multiple	Duration of postoperative analgesia, sensory block and motor block (hours): 2mg-20.0±5.7, 16.6±4.6, 14.9±4.5 4mg-22.7±6.0, 18.0±5, 16.1±4.9 8mg-22.0±7.4, 17.3±4.8, 15.3±4.5 respectively Performance time (min) 6.2±2.3 (2mg), 6.3±2.4 (4mg), 6.7±2.6 (8mg)	Vascular puncture: 6 (5.0%) (2mg group), 4 (3.3%) (4mg group), and 3 (2.5%) (8mg group)

Hong B et al (2018),[55]	25ml of LA (1:1 mixture of 1% lidocaine and 0.75% ropivacaine) D group: sedation with dexmedetomidine (0.7–0.8 mg/kg/hr) M group: midazolam (3 mg of midazolam if over 60 kg, 2 mg of midazolam if less than 60 kg)		Time to first request for analgesic (min): D group-616.9± 158.2, M-group-443.7±127.2	PONV/dizziness/dry mouth/headache: D group-12.2%/8.2%/8.2%/0, M group-23.4%/0/2.1%/2.1%
Hamed MA et al (2018),[56]	0.5 ml/kg up to a maximum of 40 ml (the dose of bupivacaine was 1.5 mg/kg). Group C: isobaric bupivacaine 0.5%. Group D: 1 mg/kg of dexmedetomidine along with equal volumes of 0.5% isobaric bupivacaine. Group F: 1 mg/kg of fentanyl along with equal volumes of 0.5% isobaric bupivacaine.	Multiple	Onset of motor and sensory block: 6.85 ± 2.4 and 5.75 ± 2.2 (Group D), 13.7 ± 3.3 and 11.8 ± 3.4 (Group F), 18.4 ± 5.2 and 16.3 ± 4.8 (Group C) Duration of motor and sensory block: 777 ± 74.6 and 819 ± 76.6 (Group D), 465.5 ± 46.8 and 500.2 ± 37.2 (Group F), 420.5 ± 44.4 and 473.9 ± 36.8 (Group C)	PONV: 2 patients (fentanyl group)

Aliste J et al (2018),[57]	ISBPB-20 ml of levobupivacaine 0.5% and epinephrine 5µg/ml Small volume SBPB-3 and 17 ml were deposited at the corner pocket and posterolateral to the brachial plexus	Multiple	Performance time, min-7.7 (ISBPB), 7.3 (SBPB) Onset time, min: 10.4 (ISBPB), 24.4 (SBPB)	PONV: 1 (4.5) (ISBPB), 1 (4.5%) (SBPB)
Auyong DB et al (2018),[58]	15 ml, 0.5% ropivacaine	Multiple	-	Vomiting, n (%): 9 (15%) (ISBPB), 5 (8%) (SBPB), 2 (3%) (suprascapular)
Sinha C et al (2018),[59]	20 cc 0.5% levobupivacaine. Group I: 1 µg/kg dexmedetomidine Group II: 2 µg/kg dexmedetomidine	Multiple	The average time for onset and duration of sensory and motor blockade was similar in both the groups.	-
Dharmarao PS et al (2018),[60]	Group A: 30 ml of 0.5% ropivacaine with 1 µg kg-1 dexmedetomidine Group B: 30 ml of 0.5% ropivacaine with 1 µg kg-1 fentanyl	Multiple	Onset of sensory blockade: 13.95±1.34 min (group A), 14.18±1.41 min (group B). The duration of motor blockade: 649.56±42.73 min (group A), 456.75±32.93 min (group B).	Nausea/ Vomiting: 7.5% (Group A), 5% (Group B)

Mangal V et al (2018),[61]	20 ml 0.75% ropivacaine Group A: 2 ml 0.9% normal saline Group B: dexmedetomidine (1 µg/kg body weight)	Multiple	Sensory and motor block: 613.34 ± 165.404 min and 572.7 ± 145.709 min in group B and 543.7 ± 112.089 min and 503.26 ± 123.628 min in group A; P < 0.01). Duration of analgesia: 593.19 ± 114.44 min (group A), 704.8 ± 178.414 min (group B); P < 0.001).	-
Elyazed MAM et al (2018),[62]	35 ml ropivacaine 0.5% diluted with 4 ml normal saline 0.9%. Group I: Magnesium sulfate 150 mg Group II: dexmedetomidine 100 µg	Multiple	Dexmedetomidine group provided the longest duration of analgesia as compared to ropivacaine group (P = 0.000) The mean onset time: 20.23 ± 3.34 (ropivacaine group), 20.77 ± 2.55 min (mgso4 group), and 17.26 ± 2.60 min (dexmedetomidine group) (P = 0.000).	PONV: 8.5% (ropivacaine and mgso4 groups) and 11.4% (dexmedetomidine group),

Karaman Tet al (2019),[63]	20 ml of 0.25% bupivacaine	Multiple	Onset time of sensory block (min): 11.55 (ISBPB), 12. 28 (SBPB) Duration of surgery: 120 min (ISBPB) and 140 min (SBPB)	-
Sivashanmugam T et al (2019),[64]	20ml of an equal mixture of 0.5% bupivacaine and 2% lidocaine with 1:200000 epinephrine.	Multiple	Onset time: 30 min	-
Ayyanagouda B et al (2019),[65]	Skin infiltration of 1–3 ml 1% lignocaine 20 ml 0.5% ropivacaine in 5 ml increments by extrafascial (Group E) or intrafascial (Group I) approach	Multiple	Duration of surgery: 84±24.65 min (Group E) and 90±25.38 (Group I); Sensory and motor onset time: 10±2.3 min and 7.10±1.936 (Group I), 17±1.8 and 15.69±2.625 (Group E)	-

Kaur S et al (2019),[66]	Group I = 27 ml of 0.5% ropivacaine Group II = 27 ml of 0.5% ropivacaine + 250 mg mgso4 Group II = 27 ml of 0.5% ropivacaine + 2 mg.kg^{-1} ketamine.	Multiple	Onset of motor and sensory block: 20.26±1.69 and 15.61±1.39 min (Group I), 21.11±1.52, 15.65±1.62 min (Group II), 21.00±1.26, 15.64±1.27 min (Group III) Duration of motor and sensory block: 4.51±0.70 and 4.51±0.70 min (Group I), 5.67±0.72 and 5.67±0.72 min (Group II), 4.14±0.59 and 4.14±0.59 min (Group III)	Nystagmus: 5 Hallucination: 7 patients (Group III) patients (Group III) Nausea/ vomiting: 2 patients (Group III) Hematoma: 2 patients (Group I). 2 patients (Group II) and 3 patients (Group III)
Blanco AFG et al (2019),[67]	20ml of 0.5% ropivacaine and 20ml of 1.5% mepivacaine	Multiple	Mean performance time: 4.8±2.0min (RBPB) and 5.2±2.3min (IBPB)(p=0.06)	Arterial puncture/pain: n=1.9%/3.8% (RBPB) and 7.1%/7.1% (IBPB)

Elhusein AKA et al (2019),[68]	Group I- 28 ml 0.5% bupivacaine and 2 ml 0.9% normal saline Group II- mixture of 28 ml 0.5%bupivacaine and 2 ml of mgso4 containing 200 mg mixed with 1000 unit hyaluronidase	Multiple	Onset of sensory and motor block: faster in patients in group (II) than groups (I) Duration of sensory and motor block: longer in group (II) than in group (I)	-
Singh and Singham (2019),[69]	30 ml of 0.375% injection bupivacaine.	Single	Block performance time (Sec): 190.54±20.28 (ISBPB), 220.64±25.72 (SBPB) (P<0.001) Duration of analgesia (min): 715.32±25.27 (ISBPB), 725.44±15.58 (SBPB)	-
Singh and Singham (2019),[70]	Group control (CL): Ropivacaine 0.5% (30 ml) + normal saline (1 ml), Group Clonidine (CD): Ropivacaine 0.5% (30 ml) + injection Clonidine (150 µg), Group Dexmedetomidine (DX): Ropivacaine 0.5% (30 ml) + injection Dexmedetomidine (100 µg).	Single	Onset of sensory and motor block (min): 3.93±0.98, 11.06±2.53 (CL), 3.1±0.54, 8.30±4.86 (CD), 2.5±0.73, 6.56±0.971 (DX) Duration of motor block (min)/ Duration of analgesia: 349.43±39.99/ 410.56±25.4 (CL), 408.86±42.63/472.7±28.67 (CD), 559.7±18.69/701.5±35 (DX)	

Refaat S et al (2019),[71]	30ml 0.5% bupivacaine	Single injection, Double injection, Intracluster injection	Onset of block (min): 18.00± 2.45 (Gs), 12.58±1.83 (Gd), 8.17±1.64 (Gic) (P <0.001) Duration of block (min): 125.83±43.32 (Gs), 444.17±64.73(Gd), 310±50.0 (Gic) (P<0.001)	-
Patel MA et al (2020),[72]	Group I- LB 133mg, Group II-LB 266mg, or Group III- saline placebo (20ml total volume each)	Single	-	Nausea/ headache/ constipation/ pruritis: 17/7/6/3 (GI), 3/1/2/1(GII), 26/3/9/11 (GIII)
Kasine T et al (2020),[73]	20 ml lidocaine 20 mg/ml with epinephrine 5 µg/ ml.	Multiple	Onset time: needle tip tracking- 23.6±13.2 min; without needle tip tracking- 27.0±21.0 min Block duration: needle tip tracking-128.2±39.5 min; without needle tip tracking- 143.2±48.0 min	-

Luo Q et al (2020),[74]	SBPB and CBPB-11.5 ml) of a 1:1 mixture of 2% lidocaine and1 % ropivacaine initially and then remaining 11.5 ml	Multiple	Performance time (s): 251.69± 43.17 (SBPB), 274.55±45.62 (CBPB) (p=0.01) Duration of surgery: less in CBPB	Vascular puncture (yes/no): 1/54 (SBPB), 2/5 (CBPB)
Sachdev S et al (2020),[75]	Group L: 29 ml of 0.5% levobupivacaine+1ml of normal saline. Group LD: 29ml of 0.5% levobupivacaine + 1ml of dexmedetomidine 1ml(100mcg).	Multiple	Onset of sensory- and motor block: 12.4±3.1 min, 15.9±2.7 min (Group L), 20.5±3.8 min, 22.1±3.2 min (Group LD). The duration of sensory and motor block and duration of analgesia was longer in Group LD than Group L	
Singh N et al (2020),[76]	30 ml of 0.5% ropivacaine Group 1 (n = 20): 1 µg/kg of dexmedetomidine, group 2 (n = 20): 8 mg of dexamethasone in addition to ropivacaine, while group 3 (n = 20): only ropivacaine	Multiple	Onset of sensory and motor block: group 1 (13.5 ± 4.1 and 17.0 ± 4.1 min) and group 2 (15.6 ± 3.6 and 18.5 ± 3.7 min) as compared to group 3 (20.1 ± 5.3 and 24.9 ± 5.6 min; P < 0.001) Block duration: significantly longer in group 1 and group 2 Duration of analgesia: prolonged in group 1 and 2 than group 3. (P < 0.001)	

Lotfy ME et al (2020),[77]	Group C: 30ml0.5%bupivacainewith 1mlnormal saline, groupf: 30ml bupivacaine 0.5% with fentanyl 50µg (1ml), Group D:30ml bupivacaine 0.5% with dexmedetomidine 75µg (1ml).	Multiple	Group D showed significantly rapid onset and longer duration of sensory and motor block, prolonged duration of anesthesia and analgesia Duration of surgery (min): 109.8±29.4 (Group C), 98.3±30.9 (Group F), 109.7±33.4 (Group D),	Nausea and vomiting: 0 (Group C), 10% (Group F), 3.3% (Group D) Pruritus: 0 (Group C), 6.7% (Group F), 0(Group D)
Youssef MY et al (2020),[78]	Group B: 20ml bupivacaine (0.5%) plus 2ml of saline; Group K: 20ml bupivacaine (0.5%) and ketamine 1.5mg/kg; Group D: 20ml bupivacaine (0.5%) and dexamethasone 8mg; Group E: 20ml bupivacaine and epinephrine (5µg/ml).	Single	Group D showed a shorter onset of sensory and motor blocks compared with the other groups. Duration of analgesia (h): 7.98±0.28 (Group B), 8.00±0.00 (Group K), 8.40±2.19 (Group D), 21.57±1.36 (Group E) ($p<0.001$)	Nausea and vomiting: 2 (6.7) (Group B), 1 (3.3) (Group K), 2 (6.7) (Group D), 0 (Group E)

PONV: Postoperative nausea and vomiting

Table 3: Different types of BPB techniques and their related complications

Study	Approach used	Technique of block needle insertion	Complications	Successful/failed blocks	Outcome of the study
Mak PHK et al (2001),[6]	SBPB	-	HDP: total-51%, partial-39%, No paralysis-51%	-	Risk of unilateral HDP is high with SBPB
Deleuze A et al (2003),[7]	IBPB And AXB	-	Horner's syndrome: 2 patients (IBPB)	Success rate was 90% and 88% in groups IBPB and AXB	A single shot IBPB is equally effective as a triple-nerve stimulation Axillary block

Rettig HC et al (2005),[10]	Vertical IBPB and axillary blocks	-	Horner's syndrome: 1 patient (IBPB) and nil (axillary) Shortness of breath: 1 patient (IBPB) and nil (axillary) Paraesthesia/ dysaesthesia: 4 (IBPB) and 3 (axillary)	Complete blockade: 97% (IBPB) and 77% (AXB).	IBPB approach provides a more complete block than the AXB
Liu FC et al (2005),[11]	AXB	-	Paraesthesia: 3 (10) (ND), 0 (0) (UD), 0 (0) (US) p = 0.03	Success rate: 90% in ND and UD groups , 70% in US group	US-guided AXB, using either single- or double-injection technique, provided excellent results
Heid FM et al (2005),[12]	Vertical IBPB and high axillary plexus block	-	Horners' sign 30min after the injection: I patient (HAP)	-	Vertical IBPB demonstrated a partially higher success rate and a faster onset
Soeding PF et al (2005),[13]	US-guided ISBPB, and AXB	-	Paraesthesia: higher in the control group (P=0.012) as compared to US group	-	US guidance reduces the incidence of paraesthesia

Pippa P et al (2006),[14]	Winnie - ISBPB and Pippa proximal cranial needle approach.	PNP: 0 (Group I) and 8 (Group II) (P=0.002) Bradycardia and hypotension:0 (Group I) and 20 (Group II) Horner's syndrome: 18 patients in Group II	Excellent: 28 (group I), 19 (group II) Failure: 0 (group I) and 1 (group II)	The lower concentration of the anesthetic solution avoids complications while increased volume provides analgesia
Chan VWS et al (2007),[15]	AXB (nerve-stimulator real-time ultrasound guidance and combined US and NS (USNS)	Transient post-block paresthesia (< five days): 13 patients in both Groups US and NS and nine in Group USNS	Block success rate-82.8% (US), 80.7% (USNS, 62.9% (NS) (P = 0.0).	US guidance, with or without concomitant nerve stimulation, significantly improves the success rate of AXB
Riazi S et al (2008),[16]	US-guided In-plane ISBPB	Hypoxia and respiratory distress: 1 patient (Group II) Ipsilateral Horner's syndrome: 3 patients (Group II) Hiccups lasting for 3 days: 1 patient (Group II) Post-block hoarseness: 3 patients (Group II)		Use of low-volume US-guided ISBPB is associated with fewer respiratory and other complications

Dhir and Ganapathy (2008),[17]	US-guided continuous IBPB	In-plane	Paraesthesia- 2 patients of ST group (Tingling and numbness in the thumb region on day 4-1 patient and numbness over the incision site that recovered in 3 weeks-1 patient.)	Block success: 96% (US), 58% (ST), 59% (TR) (P<0.0005)	Post-operative block success:3 (TR), 15 (ST), 20 (US)
De Jose Maria B et al (2008),[18]	US-guided SBPB and IBPB	In-plane (SBPB) and Out-of-plane (IBPB)	-	Failed block-5 in IBPB and 2 in SBPB	The supraclavicular approach of the brachial plexus was faster
Tran DQH et al (2009),[19]	US-guided IBPB	In-plane	Horner's syndrome,-n (%): 2 (4.5) (single injection), 1 (2.2) (double injection) Paresthesia, n (%): 4 (9.1) (single injection), 4 (9.1) (double injection)	-	The double-injection IBPB provides no significant advantages
Koscielniak-Nielsen JZ et al (2009),[20]	SBPB and IBPB	In-plane	Paraesthesia: 8 patients (IBPB) and 22 (SBPB) (P=0.003) Horner syndrome: Nil (IBPB) and 17 patients (SBPB) (P<0.0001) HDP: Nil (IBPB) and 7 patients (SBPB) (P<0.0001)	Partial block failures: 4 (group I) Partial-12 and one complete failure (Group S)	IBPB had a faster onset, better surgical effectiveness and fewer adverse events

Renes SH et al (2009),[21]	US-guided ISB along with GA 2 groups (US and NS)	-	US-ISB: 2 patients with complete paresis, NS-ISB: 12 patients showed complete and 2 patients had partial HDP. .Ventilatory function was reduced in the NS-ISB group.	Block success rate: 100% (US) and 93 (NS)	US-guided ISB reduces the incidence of HDP
Renes SH et al (2009),[22]	US-guided SBPB	In-plane	HDP: 0 patient (US group), 15 patients show complete and 1 patient showed partial HDP (P<0.0001) (NS group) Horner syndrome: 7 patients (US group), 8 patients (NS group)	Block failures: 2 (NS group)	US-guided SBPB is not associated with HDP
Tran DQH et al (2009),[23]	US-guided SBPB, IBPB and AXB	In-plane (all three)	Paresthesia: 4 (10%) (SBPB), 3 (7.5%) (IBPB), 6 (15%) (AXB) Horner syndrome: 15 (37.5) (SBPB), 2 (5) (IBPB), 0 (0) (AXB) (P<0.001)	Similar success rates for the 3 groups (95%-97.5%).	US results in similar success rates for all 3
Yang CW et al (2010),[24]	SBPB and IBPB	-	Horner syndrome: 27 patients (SBPB), 4 (IBPB) Dyspnea: 3 patients (SBPB), 0 (IBPB) Pneumothorax: 2 patients (SBPB), 0 (IBPB)	Complete failure: 1 (group S) and 0 (group I)	The IBPB approach may be preferred due to lesser complications

Parrington SJ et al (2010),[25]	SBPB	In-plane	Numbness/tingling-on POD 14: 5 (21%) (Group 1), 8 (44%) (Group 2)		The addition of dexamethasone to mepivacaine prolongs the duration of analgesia
Gianesello L et al (2010),[26]	AXB	-	Accidental paresthesia: 2 patients (Group I) and 2 patients (Group II)	-	No serious complications in either of the groups
Thomas LC et al (2011),[27]	US-ISBPB and NS-ISBPB	In-plane	Paresthesia-1 (US group), 1 (NS group); Pain upon injection: 0 (US group), 2 (NS group); Neurologic Complications: Numbness >2 wk-1 (US group), 0 (NS group); Radiating pain >2 wks-4 (US group), 6 (NS group); Motor weakness>2 wks-2 (US group), 0 (NS group);	Block success rate: 95% (US group), 91% (NS group)	US-guided ISBPB is safe and effective
Lee JH et al (2011),[28]	US-guided ISBPB	In-plane	HDP: 10 (33%) (Group 5), 18 (60%) (Group 10) (P<0.05) Complications: 2 (6.7%) (Group 5), 4 (13.3%) (Group 10)	-	ISBPB with 5 ml LA showed reduce incidence of HDP

Subramanyam R et al (2011),[29]	US-guided SBPB by lateral or medial needle approach	In-plane	Paresthesias in operative extremity: 1 (3) (lateral approach), 4 (11) (medial approach) Weakness in operative extremity: 2 (6) (lateral approach), 3 (8) (medial approach),	-	Rates of sensory and motor block is similar in all groups
Sinha SK et al (2011),[30]	US-guided ISBPB	In-plane	HDP after 15 min: 14 of 15 patients in each group; At discharge: 13 of 15 patients in each group	-	Decreasing the volume for ISBPB from20 to 10 ml did not reduce the incidence of HDP
Behr A et al (2012),[31]	ISBPB	In-plane	Respiratory depression: 0 (control), 2 patients (INB group), 0 (EMB group) Laryngeal nerve block: 1 patient (control), 1 patients (INB group), 0 (EMB group)		Epineural buprenorphine prolonged postoperative analgesia of MIB

Bernucc F et al (2012),[32]	PV and PN US-guided AXB	In-plane	Paresthesia: 2 patients (8%) (PV) and 13 patients (52%) (PN); (P = 0.001)	No	Both have comparable success rates and total anesthesia-related times
Kaya M et al (2013),[33]	ISBPB Group 1: single-injection group 2: control group	-	Urinary retention: 0 (Group 1), 1 (3 %) (Group 2) Horner's syndrome 2 (7 %) (Group 1), 0 (Group 2)	-	ISBPB in patients undergoing MRM improved pain scores
Saracoglu S et al (2014),[34]	AXB	-	-	-	Successful block: 24/30 patients (Pen+group) and 6/30 patients (Pen-group)
Arab SA et al (2014),[35]	US-SBPB (Single vs triple injection)	-	Symptomatic HDP: 0 (SI) and 1 patient (TI) Horner syndrome: 2 patients (SI) and 3 patients (TI)	Successful anesthesia: 87% –single injection, 96%-multiple injection	TI technique for SBPB resulted in improved onset and more complete sensory block

Yazer MS et al (2015),[36]	US-guided targeted intracluster injection SBPB and IBPB	In-plane	Paresthesia: 6 (18.7%) (SBPB), 1 (3.1%) (TII-IBPB) Horner syndrome:17 (53.1%) (SBPB), 1 (3.1%) (TII-IBPB) Block-related pain (scale 0–10): 2 [0–7] (SBPB), 3 [0–9] (TII-IBPB)	Similar success rate in both groups (93.7-96.9%)	Both techniques provide comparable success rates
Bharti N et al (2015),[37]	US-guided SBPB, IBPB and C-6 ISBPB	In-plane	Transient phrenic nerve palsy: 2 patients (10%) (ISBPB)	Success rate: 86% (SBPB), 90% (IBPB) and 84% (ISBPB)	ISBPB has longer onset time and incidence of PNP
Bjørnholdt KT et al (2015),[38]	ISBPB	In-plane	Severe dyspnoea and pulmonary embolism: 1 patient (ISBPB group)	Failed blocks-7/27 (ISBPB)	LIA provided inferior analgesia but lesser complication then ISBPB
Singh S et al (2015),[39]	US-guided-SBPB and NS-SBPB	-	-	Successful block-90% (US group), 73.1% (NS group)	SBPB is safer and faster

Ryu T et al (2015),[40]	Comparison of ISBPB and SBPB groups	In-plane-ISBPB	Horner's syndrome: 59.6% (ISBPB group) and 19.6% (SBPB group), P<0.001). Hypotensive bradycardiac events: 12.8% (ISBPB) and 4.3% (SBPB) Hoarseness-10.6% (ISBPB), 4.3% (SBPB)	-	SBPB produces a better motor blockade and a lower incidence of Horner's syndrome than ISBPB
Liu GY et al (2015),[41]	US-guided SBPB and NS-SBPB	In-plane	Lung puncture and pneumothorax: 1 patient (NS-group)	-	US-guided SBPB is feasible and almost have no complications
Kooloth RA et al (2015),[42]	SBPB	-	Horner's syndrome: Group R -1 (3.33%), Group B- 3(10%)	-	SBPB using 0.5% ropivacaine is similar to 0.5% bupivacaine.

Petrar SD et al (2015),[43]	US-guided SBPB and ISBPB	In-plane	HDP: 11 (34%) (SBPB) and 1 (3%) (ISBPB) (P=0.001) Complete or partial paralysis: (44%) (SBPB) and (13%) (ISBPB) Dyspnea: 8(25%) (SBPB) and 5(16%) (ISBPB)	-	The incidence of HDP is less in ISBPB as compared to SBPB
Palhais A et al (2016),[44]	US-guided ISBPB	In-plane	HDP: 90% (conventional) and 21% (extrafascial) (P<0.0001). Hoarseness: 35% (conventional) and 5% (extrafascial) (P<0.02). Claude-Bernard-Horner syndrome: 35% (conventional) and 20% (extrafascial). Paraesthesia: 30% (conventional) and 0% (extrafascial).	-	US-guided ISBPB with an extrafascial injection reduces the incidence of HDP
Stav A et al (2016),[45]	US-guided SBPB, IBPB and axillary	In-plane	Transient Horner syndrome: 3 patients (SBPB)	Failed block: 10 (SBPB), 10 (IBPB), 16 (AXB)	All 3 approaches produce similar anesthesia

Wiesmann T et al (2016),[46]	Comparison of continuous SBPB and ISB	Out of plane-ISB, In-plane –SBPB	HDP: 43% in ISBPB, 24% in SBPB, (P = 0.047). Hoarseness- 6 patients in each group Horner syndrome-12 patients in ISBPB and 2 patients in SBPB (POD 1) After 1 week-dyspnoea (1 patient in each group), hoarseness (1 patient in SBPB)	-	Significantly greater incidence of phrenic nerve palsy in ISB group
Koh WU et al (2016),[47]	Comparison of continuous SBPB and ISB	In-plane approach for both	HDP: 63% (ISBPB) Horner's syndrome: 37% (ISBPB) vs 14% (SBPB); p = 0.04] Complete loss of sensation of the upper extremity: 32% (ISBPB) vs 68% (SBPB); p = 0.004].	-	Continuous supraclavicular block can be an effective modality for postoperative analgesia after open rotator cuff repair
Ghodki and Singh (2016),[48]	US-guided ISBPB and NS-ISBPB	In-plane	HDP: POD1- Group NS (12 patients), Group US (none); (p<0.0001) Horner syndrome: Group NS (6 patients) and Group US (2 patients)	Success rate: 100% (US) and 99% (NS)	Success rate: 100% (US group) and 99% (NS group)

Stundner O et al (2016),[49]	US-guided ISBPB	In-plane	HDP: 53% (n=8) and 27% (n=4) in the 20 and 5 ml groups	-	ISBPB is associated with epidural spread irrespective of injection volume
Kim BG et al (2017),[50]	US-guided ISBPN and SBPB	In-plane for both	HDP-No/ partial/complete: 2/0/23 patients (ISBPB); 8/2/14 patients (SBPB) (p=0.021); In the PACU-2/2/21 patients (ISBPB); 9/0/15 patients (SBPB) (P=0.024) Horner's syndrome: 0 (ISBPB) and 2 (SBPB) Hoarseness: 1 (ISBPB) and 0 (SBPB) Dyspnoea: 2 (ISBPB) and 1 (SBPB) Fingertip numbness: In the PACU-25 patients (ISBPB); 24 patients (SBPB)	-	SBPB is associated with a lower incidence of diaphragmatic paresis

Albrecht E et al (2017),[51]	US-guided continuous ISBPB	In-plane	HDP- POD 1-extrafascial group (15%) and intrafascial group (41%) (P=0.01); POD 2-extrafascial group (0%) and intrafascial group (6%) (P=0.016)	Failed block: 1 patient in extrafascial group	Placement of the catheter tip immediately outside of the brachial plexus sheath reduced the incidence of HDP
Oztur NK et al (2017),[52]	US-guided IBPB	In-plane	Paresthesia during block performance: 0 (Group R), 6 (12%) (Group C)	Block success: 96% (group R), 90% (group C)	The IBPB is associated with reduced performance time and less paresthesia
Kang RA et al (2018),[53]	SBPB	In-plane	HDP: 5 patients (CP) and 12patients (NC group) (P=0.019) No paresis/partial paresis/complete paresis: 13/4/1 (CP group) and 5/9/4 (NC group)	Successful block-100% in both groups	HDP incidence is reduced when LA is injected at the corner-pocket
Bravo D et al (2018),[54]	US-guided IBPB	In-plane	Paresthesia: 4 (3.4%) (2mg group), 3 (2.5%) (4mg group) and 1 (0.8%) (8mg group)	Success rate was similar in all the three groups	2, 5, and 8 mg of dexamethasone provide clinically equivalent sensorimotor and analgesic duration

Hong B et al (2018),[55]	Brachial plexus block	In-plane	Bradycardia: 3 (6.1) 0 (0)	-	
Hamed MA et al (2018),[56]	SBPB	In-plane	Hypotension: 2 patients (dexmedetomidine group) and 1 patient (control group) Bradycardia: 1 patient (dexmedetomidine group)	-	Addition of dexmedetomidine is better in prolongation of the duration of SBPB block
Aliste J et al (2018),[57]	US-guided ISBPB and small volume SBPB	In-plane	HDP (30 min after block): 21 (95) (ISBPB), 2 (9%) (SBPB) (P<0.001) Horner syndrome: 3 (13.6) (ISBPB), 1 (4.5%) (SBPB) Paresthesia: 2 (9.1) (ISBPB), 1 (4.5) (SBPB)	-	Small volume SBPB results in less incidence of HDP as compared to ISBPB
Auyong DB et al (2018),[58]	ISBPB, SBPB and suprascapular	In-plane	Horner syndrome: 29% (ISBPB), 24% (SBPB), 8% (Suprascapular) [P = 0.005]. Hoarseness: 22% (ISBPB), 21% (SBPB), 8% (suprascapular) [P = 0.04]. Subjective dyspnea 6% (ISBPB), 3% (SBPB), 2% (Suprascapular).	-	Pulmonary function is best preserved with the anterior suprascapular nerve block

Sinha C et al (2018),[59]	SBPB		Bradycardia: 2 patients (Group I), 8 patients (Group II) (p=0.04) Hypotension: 2 patients (Group I), 6 patients (Group II)	-	Increasing the dose of dexmedetomidine increases the rate of complications
Dharmarao PS et al (2018),[60]	US-guided SBPB	In-plane	Bradycardia: 12.5% (Group A), 0 (Group B) (p=0.05) Hypotension: 2.5% (Group A), 0 (Group B)	-	Dexmedetomidine prolongs the duration of sensory and motor block
Mangal V et al (2018),[61]	US-SBPB	In-plane	Bradycardia: 4.54% (group B), 0 (group A) Horner syndrome: 11.35 (group B), 9.3% (group A)	-	Addition of dexmedetomidine prolongs the duration of analgesia.
Elyazed MAM et al (2018),[62]	US-guided IBPB		Hypotension: 14.2% (dexmedetomidine group), other groups-0% Bradycardia: 20% (dexmedetomidine group), other groups-0%	-	Dexmedetomidine provided quicker onset and longer duration of blocks
Karaman Tet al (2019),[63]	US-guided ISBPB and SBPB	In-plane	Horner's syndrome (n): 8(25.8%) (ISBPB), 1(3.4%) (SBPB) (p=0.015)	Block failure- 0 in both groups	US-guided SBPB is as effective as ISBPB

Sivashanmugam T et al (2019),[64]	Comparison of SBPB and CBPB	SBPB and CBPB-either in-plane or out-of-plane	Ipsilateral PNP-5% in CBPB and 45% in SBPB (P=0.008). Impaired diaphragmatic excursion-SBPB-33.7%, CBPB-10.7% (P=0.003) Deep breathing (SBPB-36.3% vs. CBPB group-6.6%, P=0.014)	Success rate-100% in both groups	CBPB has a lower incidence of ipsilateral PNP
Ayyanagouda B et al (2019),[65]	US-guided ISBPB	-	HDP-17% (Group E), 46% (Group I) (P < 0.0001). Paraesthesia-31% (Group I) and 0% (Group E) Hoarseness-31% (group I) and 3.4% (Group E) Horners syndrome-27.6% (Group I) and 20.7% (Group E)	-	US-guided ISBPB through extrafascial approach reduces the incidence of HDP
Kaur S et al (2019),[66]	SBPB	-	-	-	The addition of MgSO4 to ropivacaine in SBPB has a lesser incidence of side effects
Blanco AFG et al (2019),[67]	IBPB and RBPB	In-plane	Paresthesia n=5.7% (RBPB group) n=1.8% (IBPB) Horner's: n=1.9% (RBPB group), n=1.8% (IBPB)	Successful block-94.3% (RBPB), 91.1% (IBPB)	RBPB approach for brachial plexus anesthesia was similar to ICB approach

Elhusein AKA et al (2019),[68]	US-guided SBPB	In-plane	Tachycardia: 5 patients (group I) and 2 patients (group II)	-	Combination of both MgSO4 with hyaluronidase decrease analgesic requirements
Singh and Singham (2019),[69]	SBPB and ISBPB	-	Horner's syndrome: 25% (ISBPB), 3.4% (SBPB), (p=0.01) PNP: 21.4% (ISBPB), 3.44% (SBPB), (p=0.03) Hoarseness: 17.8% (ISBPB), 0% (SBPB), (p=0.01)	ISBPB-95.3% SBPB-97.2%	SBPB technique has an equal success rate and provides similar analgesic effects
Singh and Singham (2019),[70]	SBPB		Pneumothorax: 6.6% (CL), 3.3% (CD), 3.3% (DX) Horner's syndrome: 3.3% (CL), 3.3%) (CD), 6.6% (DX). (P=0.02)		Dexmedetomedine and Clonidine prolong the duration of analgesia
Refaat S et al (2019),[71]	US-guided SBPB	In-plane	Horner syndrome: 1 patient (Gd)	-	Intra-cluster technique showed rapid onset with adequate postoperative analgesia

Patel MA et al (2020),[72]	ISBPB	In-plane	Tachycardia/ sinus tachycardia): 1 (GI), 1 (GII), 1 (GIII) Nervous system disorders (Dysgeusia/ Paresthesia/ dizziness/motor dysfunction): 5 (GI), 1 (GII), 4 (GIII) Muscle twitching/ Tinnitus/visual impairment: 3/0/0 (GI), 1/0/0 (GII), 2/1/1 (GIII)	-	Single-injection BPB with LB 133mg provided analgesia through 48hours post-surgery
Kasine T et al (2020),[73]	IBPB	In-plane	Horner syndrome: 2 individuals (without needle tip tracking)	Block success rate-81% with and 69% without needle tip tracking	No significant differences between active needle tip tracking and the control procedures were found
Luo Q et al (2020),[74]	USg u i d e dfor both SBPB and CBPB	-In-plane	Horner syndrome-(yes/no): 16/39 (SBPB), 0/55 (CBPB) (p <0.01)		Multi-drug injection resulted in similar block dynamics for both techniques
Sachdev S et al (2020),[75]	SBPB		H y p o t e n s i o n :- 1 patient (LD) bradycardia: 2 patients (LD)		Dexmedetomidine added with l e v o b u p i v a c a i n e prolongs the duration of sensory as well as motor block
Singh N et al (2020),[76]	USg u i d e d SBPB	-In-plane	H y p o t e n s i o n :- 1 patient (dexmedetomidine group)		Dexmedetomidine and dexamethasone prolong' block duration.

Lotfy ME et al (2020),[77]	US-guided SBPB	Hypotension: 0-(Group C), 0 (Group F), 6.7% (Group D) Bradycardia: 0 (Group C), 0(Group F), 17.5% (Group D) (p<0.001)	Dexmedetomidine hastens the onset and prolongs the duration of blocks
Youssef MY et al (2020),[78]	US-guided-SBPB	-	- Dexamethasone has a longer duration of sensory and motor blocks

ISB: Interscalene Block; GA: general anesthesia; NS-ISBPB: nerve stimulation ISB, US-ISB: Ultrasound-guided ISBPB; US-SBPB: Ultrasound-guided supraclavicular brachial plexus block; POD: Postoperative day; CBPB: Costoclavicular brachial plexus block; PNP: Phrenic nerve palsy; HDP: Hemidiaphragmatic paralysis; NS: nerve stimulator; IBPB: Infraclavicular brachial plexus block; HAP: high axillary plexus block; AXB: Axillary block; MIB: Middle interscalene brachial plexus block; PV: perivascular (PV; PN: perineural; RBPB: Retroclavicular brachial plexus block.

Description of the Outcome Measures

A. Primary outcome measures

Complications reported in various studies (n=73)

1. Complications related to BPB [Table 3]

(a) Neurological complications: The majority of the studies (n=41) reported neurological complications. A neurologic complication was defined as neurological symptoms within the operative site brachial plexus that was related to brachial plexus irritation but were unrelated to the surgical procedure as determined by the neurologist, including Horner syndrome, numbness, paresthesia, radiating pain, motor weakness, and many more.

The 41 studies reported more than one neurological complications Among these, more than half of the studies (n=32) reported Horner

(b) Respiratory complications: A total of 23 studies have reported respiratory complications. Among them, the most common ones are hemidiaphragmatic paralysis (HDP) (n=19), followed by pneumothorax (n=3), any other respiratory complications. HDP was observed in 19 studies.[6,20,21,22,28,30,35,43,44,46,47,48,49,50,51,53,57,64,65]Diaphragmatic movement reduction of more than 75%, no movement, or paradoxical movement was considered to be "complete paresis". Diaphragmatic movement reduction between 25% and 75% was considered to be "partial paresis", and diaphragmatic movement of less than 25% was considered to be "no paresis. Three studies reported the complication of pneumothorax,[11,24,70] in which the majority of them belong to the SBPB technique. Other respiratory complications such as dyspnea,[24,38,43,46,50,58] reduce ventilator function,[21] shortness of breath,[10] deep breathing,[64] hypoxia and respiratory distress,[16] respiratory depression,[31]

pulmonary embolism,[38] and pneumothorax with lung puncture,[41] were also observed in the studies.

(c) Cardiac complications: Thirteen studies denoted cardiac complications. Among these,bradycardia and hypotension was reported in 11 studies,[14,40,56,75,76,77,55,59,60,61,62] and tachycardia/sinus tachycardia was shown in two studies.[68,72]

(d) Hoarseness: Eight studies,[16,40,44,46,50,58,65,69] reported the incidence of hoarseness among patients undergoing surgery and one study reported laryngeal nerve block with the use of ISBPB technique.[31]

(e) Phrenic nerve palsy: It was reported in four studies.[14,37,64,69]

(f) Other complications: Patel MA et al in their study reported visual impairment, ear and labyrinth disorders (Tinnitus), and muscle twitching with the ISBPB technique.[72] Urinary retention was also reported with the ISBPB technique by Kaya M et al.[33]

1. **Complications related to LA [Table 2]**

(a) Vascular puncture: Twenty

studies,[7,8,9,10,11,12,18,20,23,24,26,31,32,34,35,39,52,54,67,74] measured the incidence of vascular punctures, and a vascular puncture was determined by the presence of frank blood in the hub of the needle or aspiration of blood when the needle was attached to tubing and a syringe.

(b) Postoperative nausea and vomiting (PONV): It was reported in 15 studies.[10,25,31,33,42,55,56,57,58,60,62,66,72,77,78]

(c) Pain and bruising at the injection site: Burning pain,[29,38] tourniquet pain,[11] and axillary,[15] were observed in the studies. Apart from this, bruising was reported by Parrington SJ et al,[25] Chan VWS et al,[15] and Subramanyam R et al.[29]

(d) Other complications: Hematoma,[11,66,38] intravascular injection,[41] constipation,[72] pruritis at the site of injection,[72,77] hallucination and nystagmus by,[66] dry mouth[55] dizziness,[38,55] headache,[55,72] and dysphonia,[14] were reported as other complications in various studies.

B. Secondary outcome measures

(a) Block performance time: Twenty one studies,[7,8,9,15,19,20,26,30,32,34,35,36,37,46,48,52,54,57,67,74,69] reported block performance time. Performance time was measured by the stopwatch by the anesthesiologist performing the block from needle insertion until finishing local anesthetic injection in these studies[Table 2].