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The role of regional anaesthesia techniques in the management of acute pain

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SUMMARY

Regional anaesthesia and analgesia techniques are used to effectively manage acute pain after a variety of surgeries. With the rapid growth of ultrasound-guided procedures, anaesthetists are re-examining regional anaesthesia and analgesia and their roles in pain management. In this evolving field previous published data may not reflect current practice. Therefore, a narrative review of recent literature was undertaken to establish the current utility and efficacy of regional anaesthesia and analgesia for the management of acute pain following surgery. Only prospective randomised controlled trials published between March 2009 and March 2011 with outcome measures of analgesia efficacy were included. Sixty-five randomised controlled trials were identified involving 4841 patients. Regional techniques for the management of knee (26%), abdominal (26%) and shoulder (14%) surgery were most frequently studied. The review provides further evidence that regional anaesthesia and analgesia can offer excellent analgesia with acceptable side-effects for the management of post surgical pain. In addition, the results of this review support the use of ultrasound guidance when performing regional techniques and continuous catheter techniques to prolong analgesia.

Key Words: regional anaesthesia, acute pain, nerve block, postoperative pain, analgesia

Regional anaesthesia and analgesia (RA&A) techniques are commonly used following major surgery to provide superior acute pain relief, reduce opioid side-effects and improve functional capacity when compared with systemic-only analgesia regimens. RA&A is experiencing a renaissance with the advent of ultrasound (US)-guided procedures and anaesthetists are re-examining the role of RA&A in anaesthesia and pain management. It is now clear that US-guided regional anaesthesia increases block success, reliability and effectiveness, especially when performed by experienced practitioners[1,2]. The volume of literature on RA&A has increased significantly over recent years including published accounts of new techniques and approaches. Anaesthetists are now able to image nerves, nerve plexuses and structures relevant to the safe and efficient conduct of RA&A. Technological advances, such as US-guidance and purpose-designed catheter systems, coupled with an increasing evidence base in favour of RA&A has resulted in more anaesthetists performing RA&A. Therefore, previously published data on RA&A before US-guidance may not reflect current practice. The purpose of this narrative review of the recent literature was to describe the utilisation and efficacy of RA&A in contemporary clinical practice for the management of acute pain following surgery.

METHODOLOGY

The Cochrane Central Register of Controlled Trials (CENTRAL) (The Cochrane Library, current issue), MEDLINE (1987 to date) and EMBASE (1987 to date) were searched using the MeSH terms: anesthesia, conduction/anesthesia, local/nerve block or keywords regional an(a)esthesia combined with MeSH terms analgesia/pain/postoperative pain or key word acute pain for the two-year period from March 2009 to March 2011. Only prospective randomised controlled trials (RCT) with outcome measures of analgesia efficacy (i.e. pain scores or analgesic sparing measurements) of RA&A techniques were included in the review. The quality of reports was assessed using methodology described by Jadad[3]. Each publication (excluding foreign language papers) was assigned a 'Jadad quality score' from 1 (minimum) to 5 (maximum).

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TABLE 1
Summary of included studies

First author, reference	Journal	Study size, n	Surgery type	US Y/N	Intervention	Analgesic endpoint	Analgesic results	Jadad scale
Lower limb surgery								
Knee surgery								
Fredrickson MJ[18]	Anaesth Intensive Care	45	TKA	Y	US vs NS placement of continuous FNB	Worst pain score, supplementary analgesia in first 48 h	No difference between the two groups	3
Carli F[14]	Br J Anaesth	40	TKA	N	LIA vs continuous FNB	Postoperative morphine consumption and pain scores	FNB group used less morphine at 24 and 48 h	5
Sundarathiti P[8]	J Med Assoc Thai	61	TKA	N	CEA vs continuous FNB	Pain scores and tramadol requirements	Pain scores and tramadol requirements were higher in the FNB group at 6 and 12 h but not at other times postoperatively	2
Farid IS[11]	J Clin Anesth	23	Knee reconstruction surgery	N	FNB vs fascia iliaca block	Postoperative morphine consumption and pain scores	No difference between the two groups	2
Kadic L[6]	Acta Anaesthesiol Scand	53	TKA	N	Continuous FNB vs no RA	Postoperative morphine consumption and pain scores	Patients receiving FNB had lower pain scores, required less morphine and were more satisfied	3
Shum CF[5]	J Arthroplasty	60	TKA	N	High-dose continuous vs low-dose continuous FNB vs no RA	Postoperative morphine consumption and pain scores	There were lower pain scores, higher satisfaction, and lower morphine us in patients receiving FNB regardless of ropivacaine dose	2
Dauri M[13]	Reg Anesth Pain Med	50	Knee reconstruction surgery	N	Continuous FNB vs continuous LIA (wound and intra-articular) infusions	Postoperative morphine and ketorolac consumption and pain scores	Continuous FNB group had lower pain scores and required less morphine and ketorolac boluses	1
Lee AR[9]	Yonsei Med J	78	TKA	N	FNB vs no FNB. All patients received patient controlled CEA	Pain scores and volume of patient controlled CEA and rescue analgesic requirements	Pain scores and CEA volumes were lower in the FNB group	3
Yu HP[4]	Zhongguo Gu Shang (Chinese)	80	TKA	N	Continuous FNB vs no FNB	Pain scores	Pain scores were lower in the continuous FNB group	Not ranked
McMeniman TJ[10]	J Arthroplasty	98	TKA	N	Continuous FNB vs continuous fascia iliaca block	Fentanyl and tramadol requirements	No difference between the two groups	3
Wulf H7	Acta Anaesthesiol Scand	280	Knee reconstruction surgery	N	4 study groups: 30 ml FNB 0.2% ropivacaine vs 0.75% ropivacaine vs 0.25% bupivacaine vs saline placebo	Pain scores and motor block were assessed at 4 h	Pain scores were higher in the placebo group	3
Spreng UJ[15]	Br J Anaesth	102	TKA	N	LIA vs CEA	Pain scores and morphine consumption	Early pain scores were lower in epidural group but lower in LIA group at rest beyond 24 h. Cumulated morphine over 72 h was lower in the LIA group	3
Frassanito L[12]	Eur Rev Med Pharmacol Sci	52	TKA	Y	Intrathecal morphine vs FNB	Pain scores and PCA morphine consumption	Pain scores were lower in the intrathecal group	3

TABLE 1

Summary of included studies (continued)

First author, reference	Journal	Study size, n	Surgery type	US Y/N	Intervention	Analgesic endpoint	Analgesic results	Jadad scale
Aveline C[17]	Eur J Anaesthesiol	93	TKA	Y	Combined US- and NS-guided continuous FNB vs NS alone	Local anaesthetic consumption, pain scores and morphine requirements	Pain scores, morphine and local anaesthetic requirements were lower in the combined US and NS group. Total morphine and LA requirements were lower in the US guided group	4
Hunt KJ[19]	J Arthroplasty	88	TKA	N	SNB vs no SNB. All patients received FNB	Pain scores and morphine requirements	Morphine use was lower in the SNB group	2
Wang A-Z[16]	Reg Anesth Pain Med	50	TKA	Y	Perpendicular vs parallel FNB catheter placement	Pain scores and morphine consumption	No difference between the two groups	3
Jansen TK[20]	AANA J	56	Knee reconstruction surgery	N	SNB vs no SNB. All patients received FNB	Analgesic requirements, pain scores and satisfaction score	Lower analgesic requirements and pain scores in the SNB group	3
Hip surgery								
Segado Jimnez MI[26]	Publicado en Rev Soc Esp Dolor (Spanish)	90	Hip surgery	N	No RA vs fascia iliaca block vs combined FNB and obturator nerve block	Pain and satisfaction scores, time elapsed until start of rehabilitation, need for postoperative analgesics	Pain scores and analgesic requirements were lower in RA groups. No differences between RA groups	Not ranked
Dadure C[21]	Ann Fr Anesth Reanim (French)	40	Paediatric pelvic and femoral osteotomy	N	CEA vs continuous psoas compartment block	Pain scores and analgesic requirements	No difference between the two groups	Not ranked
Marino J[23]	J Bone Joint Surg Am	225	Total hip arthroplasty	N	Continuous FNB or lumbar plexus blocks vs no RA	Pain scores and analgesic requirements	Both RA techniques lowered hydromorphone consumption and delirium. No difference between RA techniques	3
Lako SJ[25]	Anesth Analg	30	Pelvic osteotomy	N	Continuous fascia iliaca block (surgically placed) vs no RA	Pain scores	Lower pain scores with continuous fascia iliaca group	4
Ilfeld BM[24]	Anesth Analg	47	Total hip arthroplasty	Y	Continuous FNB vs a continuous posterior lumbar plexus block	Pain scores and analgesic requirements	No difference between the two groups	3
Duarte LTD[22]	Rev Bras Anestesiol (Portuguese)	41	Total hip arthroplasty	N	CEA vs continuous lumbar plexus block	Pain scores, rescue analgesia, PCA bolus requirements	There were lower pain scores and morphine consumption in the CEA group	Not ranked
Ankle and foot surgery								
Blumenthal S[28]	Br J Anaesth	50	Major ankle surgery	N	Continuous FNB vs no FNB. All patients received continuous popliteal SNB and spinal anaesthesia	Pain scores and morphine PCA requirements	Continuous FNB group had lower pain scores in the postoperative period and at 6 months. Morphine consumption was lower in the continuous FNB group	3
Zaric D[29]	Acta Anaesthesiol Scand	40	Chevron osteotomy for hallux valgus	N	Continuous popliteal SNB with 0.2% ropivacaine 5 ml vs 8 ml/h	Pain scores and opiate consumption	No difference in pain between the two groups	5

TABLE 1
Summary of included studies (continued)

First author, reference	Journal	Study size, n	Surgery type	US Y/N	Intervention	Analgesic endpoint	Analgesic results	Jadad scale
Saricaoglu F[30]	Turkiye Klinikleri J Med Sci (Turkish)	32	Foot surgery in children	Y	Continuous SNB vs no RA block	Pain scores and opioid consumption	Opioid consumption was lower in the continuous SNB	Not ranked
Mariano ER[31]	Can J Anesth	80	Foot or ankle surgery	Y	US vs NS (stimulating catheter) for popliteal SNB catheter insertion	Pain scores and oxycodone consumption	Pain scores were higher in the US group	3
Elliot R[27]	Foot Ankle Int	54	Foot and ankle surgery	N	Continuous vs single-injection popliteal SNB	Pain scores and analgesic requirements	Lower pain scores and analgesic requirements in the catheter group	5
Rodrigues MR[32]	Rev Bras Anestesiol (Portuguese)	118	Correction of congenital clubfoot	N	SNB and FNB, SNB and saphenous block, and SNB and LIA vs caudal	Oral morphine requirements and pain scores	No difference between the groups	Not ranked
Upper limb surgery								
Shoulder surgery								
Fredrickson MJ[38]	Br J Anaesth	87	Rotator cuff surgery	Y	Continuous ISB 5 ml/h with patient-controlled boluses vs 2 ml/h with boluses of 0.2% ropivacaine	Pain scores and analgesic requirements	No difference between the two groups	3
Yang CW[39]	Korean J Anesthesiol	62	Shoulder surgery	N	Continuous ISB with 3 ml patient controlled boluses, 8 ml/h vs 6 m/h of 0.2% ropivacaine	Pain scores and analgesic requirements	No difference between the two groups	2
Goebel S[33]	Arch Orthop Trauma Surg	70	Open shoulder surgery	Y	Continuous ISB vs ISB (patient controlled boluses of 0.2% ropivacaine vs saline infusion)	Pain scores and rescue analgesia	Ropivacaine group received less rescue analgesia	5
Fredrickson MJ[35]	Reg Anesth Pain Med	61	Arthroscopic surgery	Y	Continuous ISB with patient controlled boluses vs ISB	Pain scores and rescue analgesia	Pain scores and tramadol requirements were lower in the continuous ISB group	3
Borgeat A[36]	Anesth Analg	80	Open rotator cuff repair	N	Continuous ISB 0.2% ropivacaine vs 0.3% ropivacaine	Pain scores and morphine requirements	Total morphine consumption was lower in 0.3% ropivacaine group. Pain scores were similar in both groups	5
Winkler T[41]	J Shoulder Elbow Surg	40	Arthroscopic surgery	N	Subacromial LIA vs continuous ISB	Pain scores and analgesic requirements	Lower pain scores were recorded in the continuous ISB group	3
Mariano ER[34]	Anesth Analg	30	Shoulder surgery	Y	Continuous ISB vs ISB (0.2% ropivacaine vs saline infusion)	Pain scores, opiate requirements	Lower pain scores and opiate requirements were recorded in the continuous ISB group	5
Fredrickson MJ[37]	Br J Anaesth	65	Shoulder surgery	Y	Continuous ISB 0.4% ropivacaine vs 0.2% ropivacaine with patient controlled boluses	Pain scores, tramadol requirements and local anaesthetic bolus demands	No difference between each group	4

TABLE 1
Summary of included studies (continued)

First author, reference	Journal	Study size, n	Surgery type	US Y/N	Intervention	Analgesic endpoint	Analgesic results	Jadad scale
Fontana C[40]	Eur J Anaesthesiol	122	Shoulder arthroscopy	N	LIA vs continuous ISB vs placebo	Pain scores and fentanyl requirements	There were lower fentanyl requirements in the ISB group compared with LIA. There were lower pain scores in LIA compared with placebo	4
Upper limb surgery (excluding shoulder)								
Mariano ER[43]	Reg Anesth Pain Med	60	Distal arm surgery	Y	Continuous supraclavicular block vs continuous infraclavicular block	Pain scores and oxycodone requirements	There were lower pain scoresand oxycodone use in the infraclavicular group	2
Shri I[44]	J Anaesthesiol Clin Pharmacol	60	Upper extremity arm surgery	N	Continuous infraclavicular block: 0.125% bupivacaine boluses vs 0.25% bupivacaine boluses vs saline placebo	Pain scores	Pain scores were lower in the local anaesthetic groups	3
O'Donnell BD[42]	Anesth Analg	30	Upper limb trauma surgery	Y	Axillary block vs no RA	Pain scores	Axillary block group had less pain at 0, 2 and 6 h	3
Thoraco-lumbar surgery								
Chest surgery								
Buckenmaier CC[45]	Pain Med	73	Outpatient breast cancer surgery	N	PVB vs PVB and continuous PVB	Pain scores	No difference between the two groups	5
Messina M[47]	Minerva Anestesiol	24	Thoracic surgery	N	Continuous PVB vs CEA	Pain scores and morphine requirements	Morphine use in the PVB group was higher	2
Boughey JC[46]	Am J Surg	80	Unilateral breast surgery	N	PVB vs no PVB	Pain scores and analgesic requirements	Early pain scores were lower in the PVB group	3
Abdominal wall surgery								
Kanazi GE[50]	Anesth Analg	57	Caesarean surgery	Y	Intrathecal morphine vs US-guided TAP block	Pain scores and morphine requirements	There were lower pain and tramadol requirements in the IT morphine group	5
Griffiths JD[55]	Anesth Analg	65	Gynae-oncology surgery	Y	US-guided TAP vs saline placebo	Pain scores and morphine requirements	No difference between the two groups	5
Fredrickson MJ[57]	Paediatr Anaesth	41	Paediatric inguinal surgery	Y	US-guided ilioinguinal block vs US-guided TAP block	Pain scores and morphine requirements	Pain was more frequent and ibuprofen use was higher in the TAP group	3
Carney J[52]	Anesth Analg	40	Open appendicectomy	N	Landmark-guided TAP block vs placebo	Pain scores and morphine requirements	TAP block group lowered morphine requirements and pain scores	5
Niraj G[53]	Br J Anaesth	52	Open appendicectomy	Y	Unilateral US-guided TAP block vs placebo	Pain scores and morphine requirements	US-guided TAP block group lowered morphine consumption and pain scores	4

TABLE 1
Summary of included studies (continued)

First author, reference	Journal	Study size, n	Surgery type	US Y/N	Intervention	Analgesic endpoint	Analgesic results	Jadad scale
Costello JF[49]	Reg Anesth Pain Med	100	Caesarean surgery	Y	US-guided TAP block vs saline placebo (all groups received intrathecal morphine)	Pain scores and morphine requirements	No difference between the two groups	5
Belavy D[48]	Br J Anaesth	47	Caesarean surgery	Y	US-guided TAP block vs saline placebo	Opiate requirements and pain scores	US-guided TAP block group lowered morphine consumption and pain scores	5
Sandeman DJ[54]	Br J Anaesth	93	Lap appendicectomy	Y	US-guided TAP block vs LIA	Opiate requirements and pain scores	No difference between the two groups	5
McMorrow RC[51]	Br J Anaesth	80	Caesarean surgery	N	Landmark-guided TAP block with and without intrathecal morphine	Opiate requirements and pain scores	Pain scores and morphine consumption were lower in the spinal morphine group and was not improved by TAP block.	5
Aveline C[58]	Br J Anaesth	273	Inguinal hernia repair	Y	US-guided TAP block vs conventional ilioinguinal/ iliohypogastric	Early and late pain scores	Pain scores and morphine consumption were lower in the TAP group	4
Trifa M[60]	Middle East J Anesthesiol	72	Outpatient elective surgery	N	0.2% ropivacaine/low volume, vs high volume/0.1% ropivacaine in ilioinguinal-iliohypogastric	Pain scores	Pain scores were lower in the 0.2% ropivacaine group	3
Shoeibi G[61]	Anesth Analg	42	Renal transplant surgery	N	Lower intercostal and ilioinguinal-iliohypogastric block vs no RA	Morphine requirements and pain scores	There were lower pain scores and opiate requirements in the block group	3
Niraj G[56]	Anaesthesia	62	Major upper abdominal surgery	Y	Intermittent bolus TAP blocks vs CEA	Pain scores and tramadol consumption	No difference in pain scores between the two groups. Tramadol consumption was higher in the TAP group	3
Jagannathan N[59]	Paediatr Anaesth	50	Paediatric groin surgery	Y	US-guided ilioinguinal nerve block vs no block. All received a single-shot caudal block	Pain scores and oral analgesic requirements	Pain scores were lower in the combined regional technique	5
Splinter WM[64]	Can J Anesth	36	Open appendicectomy	N	PVB (T11, T1 and L1) vs placebo	Morphine requirements and pain scores	PVB group used less morphine	4
Bhattacharya P[62]	Acta Anaesthesiol Scand	60	Unilateral hernia repair	N	PVB (L1) vs conventional spinal anaesthesia	Pain scores and analgesic requirements	Time to first analgesic was longer in PVB group	4
Akcaboy EY[63]	J Anesth	60	Outpatient elective surgery	N	PVB vs fast-track general anaesthesia	Pain scores and analgesic requirements	Pain scores and analgesic requirements were lower in the PVB group	3

TABLE 1
Summary of included studies (continued)

First author, reference	Journal	Study size, n	Surgery type	US Y/N	Intervention	Analgesic endpoint	Analgesic results	Jadad scale
Thyroid surgery								
Steffen T[66]	Br J Surg	159	Thyroid surgery	N	Bilateral superficial CPB vs placebo	Pain scores and analgesic requirements	Pain scores were lower in the CPB group	5
Shih M-L[67]	World J Surg	162	Thyroid surgery	N	Bilateral superficial CPB vs placebo	Pain scores and analgesic requirements	Pain scores and analgesic requirements were lower in the CPB group	4
Kesisoglou I[68]	Head Neck	100	Thyroid surgery	N	Bilateral superficial CPB vs placebo	Pain scores and analgesic requirements	Pain scores were lower in the CPB group	5
Suh Y-J[65]	Eur J Anaesthesiol	90	Thyroid surgery	N	Bilateral superficial CPB vs bilateral deep and superficial CPB vs placebo	Pain scores and analgesic requirements	Analgesic requirements and pain scores were lower in the superficial CPB	3

US=ultrasound, Y=yes, N=no, TKA=total knee arthroplasty, NS=nerve stimulation, FNB=femoral nerve block, LIA=local infiltration analgesia, CEA=continuous epidural analgesia, RA=regional anaesthesia, SNB=sciatic nerve block, PCA=patient-controlled analgesia, ISB=interscalene block, PVB=paravertebral block, TAP=transversus abdominis plane, CPB=cervical plexus block.

RESULTS

There were 65 RCTs involving 4841 patients that fulfilled our search criteria. All were randomised, but varied in study quality with a median Jadad score of 3. We have categorised them by the anatomical operative area and the results are summarised in Table 1. Knee and abdominal surgery were most frequently studied, each with 17 (26%) studies, followed by shoulder surgery with nine (14%) studies. Hip, ankle and foot, upper limb (excluding shoulder), chest and thyroid surgery accounted for the remaining 34% of RCTs. Continuous catheter techniques were investigated in 33 (51%) of the trials. US-guidance was utilised in 24 (37%) of the studies.

Lower limb surgery

Knee surgery

Seventeen RCTs including 1309 patients were identified comparing femoral nerve blockade (FNB) with systemic opioids[4-7], continuous epidural analgesia (CEA)[8,9], peripheral nerve blocks[10,11], intrathecal morphine[12] and local infiltration analgesia (LIA) techniques[13,14]. Total knee arthroplasty (TKA) was the most common operation for which FNB was utilised (13 studies). Continuous FNB was investigated in 10 studies, but no study compared single with continuous FNB techniques.

FNB (single shot or continuous) provided superior analgesia after knee surgery in all studies when compared with systemic opioid regimens or LIA techniques[4-6,13,14]. Combined FNB and CEA reduced morphine requirements and the incidence of postoperative nausea and vomiting (PONV)[9]. When CEA was compared with continuous FNB, reduced side-effects (dizziness, pruritus and PONV) were reported in the FNB group[8]. Two studies compared FNB with fascia iliaca block and found that they provided comparable analgesia for major knee surgery[10,11].

In addition to showing an analgesic benefit of FNB over LIA, Carli et al[14] found that knee function and patient mobility were improved in the continuous FNB group at six weeks. Kadic et al[6] also found FNB improved knee flexion if compared with no-block. Spreng et al[15] compared LIA with CEA and found that pain scores were only lower in the CEA group in the first 24 hours. Overall the LIA group used less morphine and mobilised faster.

US-guidance was utilised in different ways in the RCT protocols: in-plane versus out-of plane[16], in combination with nerve stimulation (NS) versus NS alone[17] and US versus NS[18]. Aveline et al[17] demonstrated improved analgesia with combined US and NS compared with NS alone for continuous FNB

for TKA. In addition US-guidance reduced needle manipulations, procedure time and procedure-related pain in two RCTs[17,18].

Finally two studies showed that sciatic nerve block (SNB) combined with FNB reduced pain scores after knee surgery compared with a single FNB[19,20].

Hip surgery

There were six RCTs comparing different RA&A techniques for hip surgery investigating 473 patients. Two trials compared continuous psoas/lumbar plexus block with CEA. In major paediatric hip surgery, Dadure et al[21] found no difference in pain scores or analgesic requirements between these two techniques. Patients in the epidural group, however, reported more side-effects (urinary retention)[21]. In contrast, Duarte et al[22] found that patients in the lumbar plexus group required additional analgesia and experienced more pain compared with CEA following hip arthroplasty.

Marino et al[23] divided 225 patients undergoing total hip arthroplasty into three groups: continuous FNB, lumbar plexus nerve block and systemic opioid. Both RA&A techniques reduced pain scores and hydromorphone requirements, lumbar plexus more than FNB. In addition, patients in the lumbar plexus group experienced fewer opioid-related side-effects, walked further and were more satisfied[23]. Ilfeld et al[24] also compared these two RA&A techniques in total hip arthroplasty. Unlike Marino et al, Ilfeld et al found that continuous FNBs provide equally effective analgesia as lumbar plexus blocks. However, like Marino et al, Ilfeld et al also found that patients in the lumbar plexus group ambulated further in the morning after surgery. Finally fascia iliaca blocks placed by surgeons or anaesthetists reduced patients' pain, sedation scores and analgesic requirements after hip and femoral surgery[25,26].

Ankle and foot surgery

Six studies involving 374 patients receiving foot and ankle operations were identified. A continuous popliteal SNB was found to reduce patients' pain scores after ankle and foot surgery compared with a single-injection SNB technique. However, with very low pain scores in both groups, the authors commented on whether the extra time and costs involved warranted the use of a continuous over a single injection technique[27]. A combined continuous FNB and popliteal SNB technique provided superior analgesia for patients undergoing major ankle surgery compared with a single continuous popliteal SNB. Pain scores remained lower in the combined group six months after surgery[28]. No analgesic variation was found if 5 or 8 ml/hour of 0.2% ropivacaine was used for a continuous popliteal SNB in patients having hallux valgus surgery[29]. Saricaoglu et al[30] demonstrated that continuous SNB can successfully be used in children for postoperative analgesia after foot surgery: compared with morphine PCA, continuous popliteal SNB reduced patients' morphine requirements, PONV, pruritus and urinary retention.

For continuous popliteal SNB, US-guidance reduced procedural time and resulted in fewer placement failures compared with stimulating catheters. However, analgesia was improved with the successfully placed stimulating catheters compared with the US-guided catheters[31].

Rodrigues et al[32] compared single-shot peripheral regional blocks with caudal analgesia in children having correction of congenital clubfoot. SNB alone or with femoral/saphenous block did not promote longer lasting analgesia or decrease morphine consumption in the first postoperative day when compared with caudal epidural block.

Upper limb surgery

Shoulder surgery

Nine studies were identified involving 617 patients having shoulder surgery. Three RA&A techniques were utilised in RCTs involving shoulder surgery; single-shot interscalene block (ISB), continuous ISB and LIA (subacromial or intraarticular). All RCTs included continuous ISB techniques. Three of the nine studies compared single-shot versus continuous regional techniques in shoulder surgery[33-35]. All showed that a continuous infusion technique provided superior analgesia. In addition, continuous ISB reduced sleep disturbance and increased patient satisfaction[34]. Four studies compared various combinations of continuous ISB local anaesthetic regimens (varying concentrations, rates and bolus doses) with inconsistent results[36-39]. Overall, patients favoured low volume infusions of weak local anaesthetic solutions with intermittent bolus doses which minimised limb numbness and weakness[37,38]. In shoulder arthroscopy continuous ISB was found to be superior in reducing patients' pain and fentanyl requirements when compared with LIA. However, LIA did reduce pain scores when compared with placebo[40]. In a similar study by Winkler et al[41], continuous ISB was also found to reduce patients' pain scores after arthroscopic surgery compared with LIA.

Arm surgery (excluding shoulder)

Three studies were identified involving 150 patients[42-44]. US-guided continuous supraclavicular

blockade was compared with US-guided continuous infraclavicular blockade in patients undergoing distal arm surgery and the infraclavicular technique resulted in improved analgesia[43]. US-guided axillary plexus block was found to provide satisfactory anaesthesia and superior analgesia when compared with general anaesthesia in patients receiving distal upper arm surgery[42].

Thoracoabdominal surgery

Chest wall surgery

Three RCTs investigating 177 patients undergoing breast and thoracic surgery were identified. Single-shot paravertebral block (PVB) was compared with a continuous PVB in a double-blinded, placebo-controlled RCT for outpatient breast surgery. Analgesia was excellent with or without a continuous PVB and the authors concluded that a continuous PVB is not justifiable in patients undergoing routine unilateral breast cancer surgery, not involving reconstruction[45]. Boughey et al[46] studied patients undergoing unilateral breast surgery and found a PVB (using a multiple injection technique from T1-T6 and ropivacaine 5 mg/kg) reduced pain scores only in the first three hours when compared with systemic analgesia. Overall there was no difference in analgesic requirements in the two groups. Messina et al[47] studied CEA versus continuous PVB for the treatment of patient pain after thoracotomy and reported morphine usage in the PVB group was increased after surgery.

Abdominal wall surgery

Seventeen RCTs involving a total of 1230 patients were identified, 11 investigating transversus abdominis plane (TAP) blocks, three ilioinguinal/iliohypogastric blocks and three PVBs.

Four RCTs investigated the role of TAP blocks in 284 patients undergoing caesarean delivery. In the absence of intrathecal opiates, Belavy et al[48] demonstrated a 50% reduction in 24-hour PCA morphine usage when US-guided TAP was combined with spinal anaesthesia. However, if intrathecal morphine was utilised, US-guided TAP block did not reduce opioid requirements following caesarean delivery[49]. When subarachnoid morphine was compared with US-guided TAP block, it was found to provide superior analgesia, but resulted in increased side-effects (pruritis, PONV)[50]. McMorrow et al[51] using the original landmark-guided technique also found spinal morphine provided superior analgesia when compared with TAP block.

Two trials looked at unilateral TAP block for patients undergoing open appendicectomy and showed reductions in pain scores and morphine requirements[52,53]. However, TAP block was not shown to be analgesic sparing in patients undergoing laparoscopic appendicectomy[54]. Griffiths et al[55] also found no benefit with single-injection bilateral US-guided TAP block for midline laparotomy for gynaecological oncology surgery. CEA was compared with US-guided TAP analgesia (using mandatory 0.375% bupivacaine bolus doses every eight hours through a subcostal TAP catheter). Patients reported similar pain scores in both groups after major upper abdominal surgery, although the TAP group required more tramadol. The authors concluded that subcostal TAP catheter bolus doses may be an effective alternative to epidural infusions for providing postoperative analgesia after upper abdominal surgery[56].

Two trials compared ilioinguinal block with US-guided TAP block. Following paediatric inguinal surgery, Fredrickson et al[57] found that US-guided TAP blocks were associated with increased pain scores and ibruprofen usage in the day-stay unit when compared with US-guided ilioinguinal block. In contrast if US-guidance was not used for ilioinguinal field block, US-guided TAP block provided better analgesia for patients in the first 24 hours postoperatively after inguinal surgery[58]. In a another study of patients undergoing paediatric groin surgery, the addition of an US-guided ilioinguinal nerve block to a single-shot caudal block decreased pain scores[59]. Using 0.2% ropivacaine compared with 0.1% ropivacaine for ilioinguinal blocks reduced patient pain scores after outpatient inguinal surgery[60].

Shoeibi et al[61] showed that a combination of lower intercostal and ilioinguinal-iliohypogastric blocks provided excellent analgesia for patients undergoing renal transplant surgery.

It was shown that effective anaesthesia and analgesia can be provided by a PVB at the level of the first lumbar vertebra for patients having unilateral inguinal hernia repair. Furthermore, when compared with spinal anaesthesia, PVB prolonged analgesia, promoted earlier ambulation and reduced the requirement for urinary catheterisation[62]. Akcaboy et al[63] also found PVB provided improved recovery, long-lasting analgesia and shorter recovery room stay when compared with LIA in patients having inguinal hernia surgery.

In children undergoing appendicectomy, a PVB (injections at T11, T12 and L1) reduced morphine requirements, but did not alter side-effects when compared with a no-block general anaesthetic technique[64].

Thyroid surgery

Four studies compared superficial cervical plexus block to placebo in patients having thyroid surgery[65-68]. All showed cervical plexus block provided excellent analgesia in the first postoperative day. In addition, one study compared deep and superficial cervical plexus block and showed that the deep block provided no clinical advantage[65].

DISCUSSION

This literature review of the utility of regional anaesthesia to manage acute pain has identified a broad range of RA&A techniques for a variety of surgical procedures.

More patients were recruited to RCTs investigating RA&A techniques for knee surgery than any other surgical region. The most common operation was TKA and FNB was the RA&A technique most commonly utilised for this surgical type. The studies in this review confirm that FNB provides superior analgesia compared with systemic opioids and reduces opioid related side-effects. Unlike central neuraxial block, FNB does not result in hypotension or urinary retention and facilitates early mobilisation. Paul et al recently published a systematic review of analgesia outcomes in RCTs that compared FNB with CEA and opioid analgesia for TKA and concluded that FNB provides superior analgesic outcomes for patients after TKA[69].

Our review identified 15 RCTs (in English) which investigated 1127 FNBs. No permanent peripheral nerve injury was reported in these studies. This supports the findings of a 20-year cohort study involving over 12,000 patients, which found that there was no increase in peripheral nerve injury following peripheral nerve block for TKA when compared with no peripheral nerve block[70]. FNB is associated with motor block which can potentially impair the early mobilisation used as part of modern fast-track surgery[71]. Despite reducing local anaesthetic dosage, FNB can still cause motor block; however surgery alone will result in some degree of motor block[71]. This review did not identify the ideal FNB analgesic regimen for knee surgery, but perhaps a low dose local anaesthetic technique titrated through a catheter similar to the technique utilised by Carli et al[14] is most suited to the fast-track surgical environment. This has the potential to minimise the motor block associated with a single injection of a large dose of local anaesthetic.

Following hip arthroplasty, spinal and epidural anaesthesia reduce pain scores, PONV and may reduce blood loss[72]. However, unlike major knee and shoulder surgery, severe pain following hip arthroplasty is perceived to be confined to the early postoperative period. This perhaps explains the paucity of studies (six) identified in this review, and therefore recommending a specific RA&A technique following an operation such as total hip arthroplasty is difficult. Nevertheless, continuous RA&A techniques (lumbar plexus and FNB) provide superior analgesia compared with opioids and analgesia equal to CEA. Both studies comparing continuous lumbar plexus block with continuous FNB for total hip arthroplasty found that patients ambulated earlier in the lumbar plexus group[23,24]. This suggests that a continuous lumbar plexus block may weaken the quadriceps femoris muscle to a lesser extent than a continuous FNB.

Continuous ISBs appear to provide the 'gold standard' of postoperative analgesia for shoulder surgery when compared with other regional techniques and systemic regimens[73] and not surprisingly, all the RCTs in this review utilised a continuous technique. Although a single-shot ISB provides excellent early pain relief, block recession can be associated with a significant deterioration in pain relief. LIA techniques for shoulder surgery have been well publicised in the recent years; however, there is limited data to support their use. In addition there are concerns that LIA may result in morbidity due to LIA chondrotoxicity[74]. The optimal ISB local anaesthetic regimen for shoulder surgery has not be defined, but like FNB for knee surgery, the results of this review favour low volume infusions of weak local anaesthetics with intermittent bolus doses.

A previously published meta-analysis has confirmed PVB or thoracic epidurals provide the gold standard of analgesia for patients undergoing thoracotomy[75]. In this review, one trial[47] showed that thoracic epidural provided superior analgesia for thoracotomy compared with continuous PVB, which contradicts Joshi et al's meta-analysis, which concluded that both techniques were just as effective[75].

US-guidance has popularised some RA&A techniques such as the TAP block. RCTs investigating US-guided TAP are featured disproportionately in this review. Our review shows that they have a proven analgesic benefit in open appendicectomy, inguinal surgery and caesarean delivery (in the absence of intrathecal morphine). However, whereas single shot TAP blocks have limited value in major abdominal surgery, continuous or intermittent bolus doses via TAP catheters may prove to be effective. In patients undergoing inguinal surgery, US-guided PVB block or US-guided ilioinguinal block provides

longer lasting analgesia and earlier ambulation with fewer requirements for urinary catheterisation when compared to spinal anaesthesia or CEA.

Due to the recent rapid evolution of RA&A techniques, we considered it appropriate to limit our focus to the previous two years. Even with this limited period, only 37% of RCTs utilised US technology, which is in contrast to 63% of procedures being performed with US in a recent large observational study[76]. Perhaps this small proportion (37%) reflects the extensive resources required to design, implement and publish RCTs, or the lag time between implementing RCTs and technological advances.

Due to the relatively small number of RCTs utilising a diverse range of RA&A techniques for varying surgeries, it is difficult to make specific analgesic recommendations from this review. The duration and intensity of pain is procedure specific and therefore dividing the review into surgical type is appropriate.

The outcome and intervention of interest in this literature review was pain and the RA&A technique used to manage pain respectively. The authors acknowledge that there are postoperative pain therapies not employing RA&A. These studies show RA&A is frequently associated with favourable analgesic outcomes when compared with techniques where RA&A is not used. As with almost all postoperative pain, the quality of analgesia will be enhanced when utilised with additional multimodal analgesia.

In conclusion, this review provides further supportive evidence for the 2010/2011 Global Year Against Acute Pain that RA&A is a superior therapy for the management of patients' postoperative pain when compared with conventional therapy, following a range of major surgical types. In particular, the use of US to locate nerves and continuous catheter techniques to prolong analgesia in the postoperative period appear to provide the optimal treatment of acute pain following major surgery.

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