REVIEW ARTICLE

An Effective Treatment in the Austere Environment? A Critical Appraisal into the Use of Intra-Articular Local Anesthetic to Facilitate Reduction in Acute Shoulder Dislocation

Fraser John Gould, MBChB, MRCSEd, MRCEM

From the British Antarctic Survey Medical Unit, South Georgia & the South Sandwich Islands.

Acute shoulder dislocation is a common injury in the outdoor environment. The objective of this systematic review of the literature was to determine if intra-articular local anesthetic (IAL) is an effective treatment that could have prehospital application. A methodical search of MEDLINE, PubMed, and EMBASE databases targeted publications from January 1, 1990 until January 1, 2017. Eligible articles compared IAL with other analgesic techniques in patients 16 years or older experiencing acute glenohumeral dislocation. Reduction success, complications, and patient-reported outcome measures underwent comparison. All identified publications originated from the hospital setting. Procedural success rates ranged widely among randomized control trials comparing IAL with intravenous analgesia and sedation (IAL 48–100%, intravenous analgesia and sedation 44–100%). A pooled risk ratio [RR] favored intravenous analgesia and sedation (RR 0.91, 95% confidence interval [CI] 0.84–0.98), but there was significant inconsistency within the analysis ($I^2 = 75\%$). IAL provided lower complication rates (4/170, 2%) than intravenous analgesia and sedation (20/150, 13%) (RR 1.11, 95% CI 1.04–1.19, $I^2 = 63\%$). One trial found a clinically relevant reduction in visual analogue pain scores when comparing IAL against no additional analgesia in the first minute (IAL 21 ± 13 mm; control 49 ± 15 mm; $P < 0.001$) and fifth minute (IAL 10 ± 10 mm; control 40 ± 14 mm, $P < 0.001$) after reduction. The results suggest that IAL is an effective intervention for acute anterior shoulder dislocation that would have a place in the repertoire of the remote physician. Further research might be beneficial in determining the outcomes of performing IAL in the prehospital setting.

Keywords: glenohumeral, analgesia, lidocaine, remote

Introduction

Acute shoulder dislocation is a common injury in people undertaking recreational activities in the outdoor environment.¹ In a 2-year observational study conducted between 2011 and 2012 in the Swiss Alps, 27% of all isolated limb injuries requiring helicopter rescue and prehospital physician attendance involved the humerus and shoulder (315/1156 patients). Dislocation was the second most common presumptive diagnosis in this series (19% of all injuries, 216/1156). Fracture was the most frequent

presumptive diagnosis (38%, 441/1156).² Dislocation of the glenohumeral joint is traditionally treated within the emergency department using closed manipulation to achieve reduction. Current literature suggests that attempts at reduction are best performed at the site of trauma, reducing the pain experienced by the patient and the risk of vascular and neurological complications.^{3,4} Radiographic confirmation of a dislocation in this setting would not be possible, but in a retrospective study examining 7209 shoulder dislocations, less than 1% of patients between the ages of 20 and 40 years had an associated fracture complicating glenohumeral joint subluxation.⁵ A fracture dislocation in this demographic was unlikely unless the clinical suspicion of a fracture was particularly high or the patient had experienced a high-energy traumatic mechanism of injury.

Corresponding author: Fraser John Gould, King Edward Point Research Station, South Georgia, c/o British Antarctic Survey, Port Stanley, Falkland Islands, SIQQ 1ZZ, South Atlantic; e-mail: f.gould@nhs.net.

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Intra-articular local anesthetic (IAL) injection is a recognized and practiced analgesic technique to aid shoulder reduction in hospital, as evidenced in a 2011 Cochrane review.⁶

The objective of this investigation was to establish through a comprehensive literature review whether IAL is an effective analgesic treatment for acute shoulder dislocation, in comparison to other forms of analgesia that may be available to a remote practitioner.

Methods

A targeted search of the MEDLINE, PubMed, and EMBASE databases, mapping to Medical Search Headings “anesthesia, local” and “shoulder dislocation” yielded the initial journal articles. Additional direct searching for “shoulder dislocation AND local anesthetic” was performed within the same database selection. Duplicate publications were removed, and abstracts were screened to assess for eligibility. Publications were included from January 1, 1990 until January 1, 2017. There were no pending trials registered on the European Clinical Trials Register on January 1, 2017.⁷ Eligible articles were randomized controlled trials (RCTs), systematic reviews, and meta-analyses that compared IAL with any other forms of analgesia, or no analgesia, in patients aged 16 years or older experiencing acute glenohumeral dislocation. Any case series or cohort study conducted in the prehospital setting involving the use of IAL was eligible for inclusion. The references cited in published systematic reviews were screened for further sources.

Qualitative assessment of RCTs used the modified Jadad quality scale components.⁸ This is an 8-point scale evaluating randomization methods, blinding, withdrawals and dropouts, inclusion and exclusion criteria, adverse events, and statistical analysis in RCTs. The modified Jadad scale accounts only for double blinding, but this may be difficult to achieve when providing analgesia for shoulder reduction. Attempts at single blinding were also included during critical appraisal. Preferred reporting items for systematic reviews and meta-analyses guidelines⁹ aided this literature review when comparing the results of review articles on this topic. Only the results from primary studies were included for data analysis. Success of shoulder reduction, rates of complication, and patient-reported outcome measures were the intended outcomes for comparison. Some complications may have been attributable to reduction technique as opposed to analgesic method. In an attempt to reduce bias, all complications reported were hand checked in the relevant article. Adverse events related to intravenous

analgesia and sedation (IVAS) were included if they were recognized complications of sedation, as defined by the World Society for Intravenous Anesthesia.¹⁰ The minimum clinically significant reduction in 100-mm visual analogue pain scores was defined as >9 mm.¹¹ VAS scores can be compared with 10-point verbal pain scales by dividing the result in millimeters by 10; therefore, a difference of 1 point was deemed clinically significant in articles using a 10-point scale.

Statistical comparisons were performed using RevMan 5.2 software. A P value of <0.05 was considered to be significant. The risk ratio (RR) was calculated using a Mantel-Haenszel fixed effects model, and heterogeneity was evaluated across applicable studies using the I^2 test as a measure of inconsistency. A forest plot was used to display results where possible.

Results

LITERATURE SEARCH

Database searching identified 116 articles. After duplicate removal, there were 44 original articles. On review of the abstracts, 15 articles met the inclusion criteria. One RCT was excluded because it looked exclusively at secondary dislocations,¹² the definition of which was unclear in the manuscript. A total of 4 meta-analyses^{6,13–15} and 8 RCTs^{16–23} compared the use of IAL with IVAS. One RCT compared IAL with nitrous oxide,²⁴ and another compared IAL against use of no additional analgesia.²⁵ All of the publications originated from the hospital rather than prehospital setting. No study included patients with posterior shoulder dislocation. There were no publications comparing IAL against oral analgesia. Qualitative analysis has been included in Table 1.^{16–25}

IAL VS IVAS

Eight RCTs identified compared IAL against IVAS.^{16–23} These trials all reported successful closed reduction as a primary outcome (Table 2^{16–25}). The local anesthetic injected was 1% lidocaine in all studies, but IVAS agents varied. Reported success rates ranged widely among studies (IAL 48–100%, IVAS 44–100%). The cumulative risk ratio between the 2 analgesic strategies favored the use of IVAS (RR 0.91, 95% confidence interval [CI] 0.84–0.98), but there was significant inconsistency when comparing primary outcomes ($I^2 = 75\%$).

Across 7 studies, a 2% complication rate was recorded from 170 patients treated with IAL (3 cases of drowsiness,¹⁶ 1 of psychological agitation interfering with the procedure¹⁸). These have been included in the analysis

Table 1. Qualitative assessment of eligible randomized trials

Author and year	Described as randomized	Appropriate randomization detailed	Described as blinded	Method of blinding detailed	Withdrawals and dropouts clear	Inclusion and exclusion criteria	Adverse event assessment	Statistical methods described
IAL vs IVAS								
Cheok et al 2011 ¹⁹	Yes	Yes	No	N/A	Yes	Yes	Yes	Yes
Hames et al 2011 ²⁰	Yes	Yes	No	N/A	Yes	Yes	Yes	Yes
Kosnik et al 1999 ²²	Yes	Yes	No	N/A	No	Yes	Yes	Yes
Matthews et al 1995 ¹⁷	Yes	No	No	N/A	Yes	No	Yes	Yes
Miller et al 2002 ²³	Yes	No	No	N/A	Yes	Yes	Yes	Yes
Moharari et al 2007 ¹⁶	Yes	Yes	No	N/A	Yes	Yes	Yes	Yes
Orlinsky et al 2002 ¹⁸	Yes	No	No	N/A	No	Yes	Yes	Yes
Suder et al 1994 ²¹	Yes	Yes	No	N/A	Yes	Yes	Yes	Yes
IAL vs nitrous oxide								
Gleeson et al 1999 ²⁴	Yes	No	No	N/A	Yes	Yes	Yes	Yes
IAL vs no additional analgesia								
Tamaoki et al 2012 ²⁵	Yes	Yes	Single	Yes	Yes	Yes	Yes	Yes

IAL, intra-articular local anesthetic; IVAS, intravenous analgesia and sedation; N/A, not applicable.

as potential symptoms of local anesthetic toxicity, but no patient received treatment for this complication (Table 3^{16–25}). Of the patients allocated to IVAS, 13% (20/152) experienced recognized complications of sedation according to the World Society for Intravenous Anesthesia tool. These included 14 moderate adverse events (requirement for reversal agents, 9; ventilatory support, 5), 5 minor adverse events (hypotension, systolic blood pressure <90 mm Hg), and 1 minimal adverse event (vomiting). The overall risk ratio favored IAL (RR = 1.11, 95% CI 1.04–1.19), and this was found across all studies ($I^2 = 63\%$). An additional 9 cases of respiratory depression were reported in 2 studies, originating from patients with a blood oxygen saturation level <92% requiring no intervention (n=5)¹⁶ or not defined (n=4)²¹ and thus of unclear clinical significance. One study was excluded from complication analysis because the data it presented was inconsistent.¹⁹ It quoted a respiratory complication rate of 13% and an overall IVAS complication rate of 29%, but these values differed from the numbers presented in figure format. It reported no complications after IAL.

The choice of intravenous sedative and analgesic agents differed among trials, with only one article comparing the use of IAL against more contemporary sedative agents such as propofol or ketamine.²⁰ This study, conducted by Hames et al, was stopped before reaching its intended sample size. It attributed early cessation to difficulty in patient enrollment, resource limitations, and low success rates in the IAL cohort (48%, 12/25). The authors similarly reported that only 48% (12/25) of patients undergoing IAL were “extremely satisfied with their level of sedation” in comparison to 79% (n=15/19) of those undergoing IVAS. This study was one of only 2 trials comparing IAL with IVAS that was able to find any form of statistical superiority in terms of patient reported outcome measures (Table 4^{16–25}).

The 4 meta-analyses identified by this appraisal each corroborate the finding that IAL appears to be similar in efficacy to IVAS in both reduction success and patient outcomes when performed in the hospital environment.^{6,13–15} However, these conclusions were all derived using a largely similar pool of primary studies.

IAL VS NITROUS OXIDE

In 1999 Gleeson et al compared the use of IAL against nitrous oxide in a single center prospective randomized trial.²⁴ The study compared patient-reported 10-point verbal pain scores between both cohorts (IAL n=15, nitrous oxide n=16). Given the nature of the intervention, blinding was not possible. A quantity of

Table 2. Comparison of primary outcome in articles comparing IAL with other analgesic strategies

Success rates of IAL against IVAS in achieving shoulder reduction									
Study	IAL group success rate			IVAS group success rate			Weight %	Risk ratio	Forest plot
	Events	Total (n)	%	Events	Total (n)	%		M–H, Fixed, 95% CI	
Cheok et al 2011 ¹⁹	26	32	91	31	31	100	18.0	0.82 [0.69–0.97]	
Hames et al 2011 ²⁰	12	25	48	19	19	100	12.4	0.49 [0.33–0.74]	
Kosnik et al 1999 ²²	25	29	86	20	20	100	13.6	0.87 [0.74–1.03]	
Matthews et al 1995 ¹⁷	15	15	100	15	15	100	8.7	1.00 [0.88–1.33]	
Miller et al 2002 ²³	15	15	100	15	15	100	8.7	1.00 [0.88–1.33]	
Moharari et al 2007 ¹⁶	24	24	100	24	24	100	13.8	1.00 [0.92–1.08]	
Orlinsky et al 2002 ¹⁸	16	29	55	11	25	44	6.7	1.25 [0.72–2.17]	
Suder et al 1994 ²¹	32	33	97	33	35	94	18.0	1.03 [0.93–1.14]	
Total (95% CI)		202			184		100.0	0.91 [0.84–0.98]	
Total events	165			168					
Heterogeneity: $\chi^2 = 27.75$, df = 7 ($P=0.0002$); $I^2 = 75\%$ Test for overall effect: $Z = 2.57$ ($P=0.01$)									

Success rates of IAL against nitrous oxide in achieving shoulder reduction								
Study	IAL			Nitrous oxide			Weight %	Risk ratio
	Events	Total (n)	%	Events	Total (n)	%	Weight %	M–H, Fixed, 95% CI
Gleeson et al 1999 ²⁴	11	15	73	15	16	94	100.0	Not estimable

Success rates of IAL against no other analgesia in achieving shoulder reduction								
Study	IAL			No additional analgesia			Weight %	Risk ratio
	Events	Total (n)	%	Events	Total (n)	%		M–H, Fixed, 95% CI
Tamaoki et al 2012 ²⁵	22	22	100	19	20	95	100.0	Not estimable

IAL, intra-articular local anesthetic; IVAS, intravenous analgesia and sedation; M-H, Mantel-Haenszel.

Table 3. Complications reported in articles comparing IAL with other analgesic strategies

Complications reported when comparing IAL against IVAS (according to the World Society for Intravenous Anesthesia tool)							
<i>Study</i>	<i>IAL</i>		<i>IVAS</i>		<i>Weight %</i>	<i>Risk ratio</i>	
	<i>Events</i>	<i>Total</i>	<i>Events</i>	<i>Total</i>		<i>M-H, Fixed, 95% CI</i>	<i>Forest plot</i>
Cheok et al 2011 ¹⁹	—	—	—	—	0.0	Not included	
Hames et al 2011 ²⁰	0	25	0	19	15.5	1.00 [0.92–1.09]	
Kosnik et al 1999 ²²	0	29	1	20	16.2	1.06 [0.93–1.20]	
Matthews et al 1995 ¹⁷	0	15	2	15	9.5	1.15 [0.91–1.20]	
Miller et al 2002 ²³	0	16	0	14	10.9	1.00 [0.88–1.13]	
Moharari et al 2007 ¹⁶	3	24	10	24	9.9	1.50 [1.04–2.17]	
Orlinsky et al 2002 ¹⁸	1	28	1	25	17.9	1.00 [0.90–1.12]	
Suder et al 1994 ²¹	0	33	6	35	20.2	1.20 [1.03–1.41]	
Total (95% CI)		170		152	100.0	1.11 [1.04–1.19]	
Total events	4		20				

Heterogeneity: $\chi^2 = 16.32$, $df = 6$ ($P=0.01$); $I^2 = 63\%$ Test for overall effect: $Z = 3.19$ ($P=0.001$)**Complications reported when comparing IAL against nitrous oxide**

<i>Study</i>	<i>IAL</i>		<i>Nitrous oxide</i>		<i>Weight</i>	<i>Risk ratio</i>
	<i>Events</i>	<i>Total</i>	<i>Events</i>	<i>Total</i>		<i>M-H, Fixed, 95% CI</i>
Gleeson et al 1999 ²⁴	0	15	0	16	100.0%	Not estimable

Complications reported when comparing IAL against no additional analgesia

<i>Study</i>	<i>IAL</i>		<i>No additional analgesia</i>		<i>Weight</i>	<i>Risk ratio</i>
	<i>Events</i>	<i>Total</i>	<i>Events</i>	<i>Total</i>		<i>M-H, Fixed, 95% CI</i>
Tamaoki et al 2012 ²⁵	0	22	0	20	100.0%	Not estimable

IAL, intra-articular local anesthetic; IVAS, intravenous analgesia and sedation; M-H, Mantel-Haenszel.

Table 4. Studies using patient reported outcome measures when comparing IAL against other analgesic techniques

<i>Study</i>	<i>Outcome measure</i>	<i>Result</i>
IAL vs IVAS		
Cheok et al 2011 ¹⁹	Difference in VAS before anesthetic and during CMR	No significant difference
	Patient satisfaction with overall procedure	No significant difference
Hames et al 2011 ²⁰	Patient satisfaction with level of sedation	IVAS superior
Kosnik et al 1999 ²²	10-point pain scale during CMR	No significant difference
Matthews et al 1995 ¹⁷	10-point pain scale during CMR	No significant difference
Miller et al 2002 ²³	VAS during CMR	No significant difference
Moharari et al 2007 ¹⁶	VAS before reduction procedure, after anesthetic	No significant difference
	VAS during CMR	No significant difference
	VAS after CMR	No significant difference
Orlinsky et al 2002 ¹⁸	Change in VAS before CMR	IVAS superior
	Overall pain reduction VAS	No significant difference
	VAS score at time of discharge	No significant difference
Suder et al 1994 ²¹	VAS score during CMR	No significant difference
	Patient satisfaction with overall procedure	No significant difference
IAL vs nitrous oxide		
Gleeson et al 1999 ²⁴	10-point pain score before anesthetic	No significant difference
	Decrease in pain score after anesthetic, before CMR	Nitrous oxide superior
	10-point pain score after CMR	No significant difference
IAL vs no additional analgesia		
Tamaoki et al 2012 ²⁵	VAS prior to CMR	No significant difference
	VAS 1 minute after CMR	IAL superior
	VAS 5 minutes after CMR	IAL superior

IAL, intra-articular local anesthetic; IVAS, intravenous analgesia and sedation; VAS, visual analogue scale; CMR, closed manual reduction.

10 mL of 1% plain lidocaine was injected into each affected joint in the IAL study group. The study concluded that a statistically significant reduction in mean 10-point pain scores was achieved after analgesia, but before shoulder reduction, in both treatment arms. The study highlighted that the effect with nitrous oxide was greater (7.8 to 2.9, $P < 0.001$) compared with IAL (7.9 to 5.2, $P < 0.05$). Both of these reductions would appear clinically significant. Confidence intervals were not provided. There was no statistical or clinical difference in preanalgesia or postreduction pain scores. Successful reduction was only achieved with the aid of unspecified supplemental analgesia in 4 patients in the IAL group ($n=15$); thus, these were considered to be treatment failures. One patient in the nitrous oxide group required IVAS, and another developed an axillary hematoma. This was attributable to reduction technique rather than analgesic strategy. There were no complications resulting from the use of IAL.

IAL VS NO ANALGESIA

One small RCT published in English but conducted in San Paulo, Brazil, looked at the use of IAL when compared with

a control group receiving no additional analgesia.²⁵ The article established that it is common practice in Brazil to undertake glenohumeral reductions in most hospitals in the country without any analgesia, and the use of IVAS or nitrous oxide is reserved for failed initial attempts. It studied 42 patients, with 20 control subjects receiving no analgesia, compared with 22 undergoing IAL alone. All reductions used a traction-countertraction technique. Preintervention pain scores were similar (IAL mean 84 ± 15 mm, control 71 ± 18 mm; $P=0.012$). There was a greater decrease in VAS pain scores over set time intervals in the IAL cohort when compared with the control in both the first minute (IAL mean 21 ± 13 mm; control mean 49 ± 15 mm; $P < 0.001$) and the fifth minute (IAL mean 10 ± 10 mm; control mean 40 ± 14 mm; $P < 0.001$) after joint reduction. This difference was both statistically and clinically significant. Patient demographics and prereduction pain scores were similar in both groups. This was a well-designed yet small study, achieving its stated power quota. The authors conclude by recommending the use of IAL when undertaking shoulder reductions in order to reduce pain, in comparison to reductions performed without analgesia. No complications resulting from the use of IAL were identified.

Discussion

The use of IAL in the prehospital or wilderness setting has not been formally studied in the literature at time of this review, but we know that shoulder reductions are performed in this environment.⁴ There is no current consensus regarding when it is safe to perform a shoulder reduction without the prior use of radiography to exclude a clinically significant fracture. The requirement for prereduction imaging in shoulder dislocation was identified as 1 of the top 5 research priorities in emergency medicine according to a 2014 Australian College of Emergency Medicine consensus meeting,²⁶ and the question remains unanswered. The Banff,²⁷ Fresno,²⁸ and Quebec²⁹ decision rules have been suggested, but all 3 await external validation.³⁰ A prospective observational validation trial using the Fresno and Quebec algorithms reached completion in 2014, but the results await publication.³¹ Despite this, a prehospital observational study advocating a new glenohumeral reduction technique before radiography in the field has shown promising outcomes. It reported success rates of up to 100% (39/39) in patients treated without the use of any supplemental analgesia.³² This study recorded no immediate or long-term complications.

The advantages of emergent reduction suggested in previous articles include a reduced risk of developing vascular and neurological complications,³ a higher initial success rate after early reduction,²² and a shorter duration of time in which pain is experienced by the patient.³²

It has been found that pain is frequently undertreated in the prehospital environment.³³ Of the limited evidence available in undertaking this review, IAL appears to be superior in comparison to no additional analgesia when looking at patient-reported pain outcomes. It also offers a favorable complication rate when compared with IVAS. Given the significant heterogeneity among studies, it is difficult to show IAL as being inferior to IVAS in terms of reduction success. Unfortunately, no studies were found comparing IAL against oral analgesia, which perhaps highlights a relevant area for future research.

Successful shoulder reduction is more likely in patients who are sufficiently relaxed and have a low level of pain during the procedure. Reduction techniques have not been compared in this review, so to comment on them is beyond the scope of this article. The method chosen has a major effect on the amount of pain experienced during any reduction attempt and the likelihood of procedural success. The use of differing methods of reduction was a significant limitation in comparing multiple studies.

Undertaking IVAS in the field has risks. It requires the operator to carry strong sedative and analgesic agents,

along with monitoring equipment. The complication rates associated with IVAS in 2 particular papers were alarmingly high.^{16,21} These studies used diazepam in combination with pethidine (meperidine), which is outdated in comparison to contemporary practice. A Dutch prospective multicenter study conducted between 2006 and 2016 identified that propofol, midazolam, and ketamine were the most frequently used drugs for sedation. Subgroup analysis found that glenohumeral dislocation represented 26% (447/1711) of all IVAS indications and was associated with an overall reduction success rate of 88% (385/436). The study recorded an adverse event rate of 11% (194/1711) in patients undergoing IVAS for all causes.³⁴ This corroborates the rate of 13% (20/152) identified by this analysis.

Regarding patient-reported outcomes, some methodological pitfalls in the primary studies should be considered before conclusions are drawn regarding their importance. As mentioned in the Results section, Hames et al asked patients in the treatment arm undergoing IAL if they were “extremely satisfied with their level of sedation.”²⁰ Those patients undergoing IAL according to the trial protocol should not have undergone any sedation at all, so the phrasing of this question may have influenced the responses obtained. The number of patients not extremely satisfied after receiving IAL (13/25) was the same as those who experienced a failed reduction (13/25). The article does not indicate whether these were the same individuals. Additionally, the measurement of pain scores from patients while they are subject to the systemic effects of IVAS and nitrous oxide may introduce bias.

Nitrous oxide is a useful analgesic, but it requires storage in a gas cylinder with a regulator valve, which must then be transported to the site of trauma. It may not be readily available at the time and site of injury. In contrast, the field medical kit carried by a responding health care provider could already contain several of the items required to perform an IAL injection, including local anesthetic for the management of other injuries common in the field.

One of the most devastating complications of IAL is the possibility of introducing infection into the shoulder joint and the subsequent development of septic arthritis. All of the trials identified in this review were too small to quantify this risk. After joint arthrocentesis, 1 Icelandic study reported the incidence of septic arthritis to be up to 1/2600, or 0.04%, per injection. However, these estimates were predominantly derived from corticosteroid procedures and not specific to the shoulder.³⁵ There were no cases of superficial or deep infection arising from IAL in any journal articles identified through a comprehensive literature search. Three cases of drowsiness were reported

as complications of IAL in this review. These originated from a single RCT and, according to the study author, were attributable to the use of other analgesics (tramadol) before enrollment.¹⁶ The patients did not receive a toxic dose of lidocaine when adjusting for body weight, nor did they demonstrate any other signs of local anesthetic toxicity. The concurrent use of oral analgesics is a confounding factor in this study, but this may be difficult to mitigate in future trial designs. To withhold oral analgesia in situations where it is readily available raises ethical concerns.

Two final points relating to IAL are worth mentioning in this discussion. First, temperature stability of pharmaceutical agents carried in a field medical kit is an important factor to consider. Lidocaine has been shown to be stable and effective in temperatures outside of the range recommended by the manufacturer, from 40°C to 4°C, without any evidence of degradation.^{36,37}

Second, from in vitro modeling, the chondrotoxic effects of single-dose local anesthetics may be damaging to the articular cartilage. Other longer-acting agents such as 0.25% bupivacaine could be used as an alternative to 1% lidocaine, providing longer-lasting analgesia and reduced chondrocyte death.³⁸ Alternative IAL agents were not compared against 1% lidocaine in any of the publications identified by this review.

Conclusion

The limited evidence identified by this review suggests that IAL is an effective intervention for acute anterior shoulder dislocation, particularly in comparison to no additional analgesia. Further research might be beneficial in determining the outcome of performing IAL in both hospital and prehospital environment, but it appears to be a useful technique that would have a place in the repertoire of the remote physician.

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