ORIGINAL ARTICLE

Bupivacaine in the emergency department is underused: scope for improved patient care

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Aims: To determine patterns of local anaesthetic use, knowledge and perceived use of local anaesthetic by emergency department doctors, and barriers to bupivacaine use.

Methods: This was a multifaceted, observational study undertaken at two large metropolitan emergency departments. It comprised a retrospective chart review of patients who had been given local anaesthetic in the emergency department, an examination of ordering records of local anaesthetics in the emergency department, and a cross-sectional survey of emergency department doctors.

Results: The charts of 95 patients were reviewed. Most (93.7%) injuries were lacerations and the most common site was the hand (41.4%). 88 (92.6%), 4 (4.2%) and 3 (3.2%) patients were given lignocaine, prilocaine (Bier's blocks) and bupivacaine (digital blocks), respectively. Four (4.2%) cases were identified for which bupivacaine was likely to have been a better alternative than the lignocaine used. These were finger/hand injuries likely to be associated with considerable prolonged pain. The emergency department pharmacy records indicated that 30 times more lignocaine than bupivacaine was ordered in 2004–5. 30 (88.2%) of 34 doctors completed the survey. Knowledge of local anaesthetic pharmacology was variable: 33% and 66% did not know that bupivacaine was more cardiotoxic and that lignocaine was more painful, respectively. The main barriers to bupivacaine use were "habit" of using lignocaine (46.7%), cardiac toxicity (40%) and slower onset (30%).

Conclusion: Bupivacaine seems to be underused in some appropriate circumstances. Accordingly, there is scope for improvement in patient care through critical evaluation of local anaesthetic practice. This is particularly necessary because barriers to bupivacaine use are often non-clinical (habit, availability, familiarity) rather than clinical (toxicity, onset time).

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In the emergency department, local anaesthetics are commonly used for a range of conditions.^{1–3} Lignocaine, bupivacaine and prilocaine are frequently used agents, but each is associated with specific advantages and disadvantages. Therefore, local anaesthetic selection for a particular clinical scenario is affected by several variables including drug potency, duration of anaesthesia, speed of onset and offset, and safety.⁴ Lignocaine is a "general-purpose local anaesthetic" used for wound repair, invasive procedures, and local and regional blocks.^{2 5 6} When used for local infiltration it has the advantages of high efficacy, rapid onset and low toxicity.^{2 5} However, its injection can be painful^{3 6} and its duration of action is moderate.^{2 5}

Bupivacaine is often recommended for prolonged procedures or when longer post-procedural anaesthesia is desirable.⁷ One study reported that bupivacaine maintained anaesthesia for almost 6 h whereas lignocaine wore off within 2 h.¹ In that study, bupivacaine considerably reduced the pain experienced after wound repair compared with lignocaine.¹ Bupivacaine has also been recommended for digital nerve blocks, because complete anaesthesia can be achieved more often.⁸ Although bupivacaine is documented to have a slower onset than lignocaine,⁸ many emergency physicians have reported them as equal.⁹ However, the high lipophilic properties of bupivacaine also means that it may be more toxic, particularly to cardiac tissue, with reports of myocardial depression, hypotension and bradycardia.^{7 10 11}

It has been reported that emergency department practitioners often provide inadequate anaesthesia for patients with painful medical conditions.^{1 12} Furthermore, local anecdotal evidence indicates that bupivacaine is rarely used in the emergency department. It is possible that bupivacaine is underused in

settings where its long duration of action may confer considerable benefit to the patient. This study examined a range of issues related to local anaesthetic use in the emergency department. It aimed to determine patterns of local anaesthetic use for specific indications, whether bupivacaine is underused and the perceived barriers to its use. It also aimed to evaluate knowledge of local anaesthetic by the practitioner, their preference for certain local anaesthetics in given clinical scenarios and their estimated usage of the local anaesthetics available. The findings will inform strategies to optimise the pain relief for specific emergency department patients.

METHODS

The study comprised a medical chart review and a descriptive cross-sectional survey. It was undertaken at the Royal Melbourne Hospital and Austin Hospital emergency departments, Parkville, Victoria, Australia, between January and April 2006. The Royal Melbourne Hospital is a tertiary referral hospital with an emergency department designated as a major trauma centre. The Austin is an urban referral hospital with a specialist spinal unit. The emergency departments treat approximately 55 000 and 50 000 patients per year, respectively. Ethics committee approval for the study was obtained at each site.

A medical chart review was conducted on patients in the emergency department who had a local anaesthetic administered. At each emergency department, the computerised patient log was used to compile a list of patients who presented during a 12-month period (1 Nov 2004 to 31 Oct 2005), were aged ≥ 18 years, and who were given ICD10 diagnosis codes for laceration, dislocation, fractures or abscess. These lists were further refined using the description of injury and management

Table 1 Distribution and nature of injuries sustained

Site of injury	Nature of injury	
	Fracture, n (%; 95% CI)	Laceration, n (%; 95% CI)
Hand and wrist	4 (4.2; 1.4 to 11)	36 (37.9; 28.3 to 48.5)
Head and neck	0 (0.0; 0.1 to 4.8)	17 (17.9; 11.1 to 27.4)
Thigh and leg	0 (0.0; 0.1 to 4.8)	14 (14.7; 8.6 to 23.8)
Forearm	2 (2.1; 0.4 to 8.1)	9 (9.5; 4.7 to 17.7)
Foot	0 (0.0; 0.1 to 4.8)	5 (5.3; 2.0 to 12.4)
Trunk	0 (0.0; 0.1 to 4.8)	5 (5.3; 2.0 to 12.4)
Arm and shoulder	0 (0.0; 0.1 to 4.8)	3 (3.2; 0.8 to 9.6)
Total	6 (6.3; 2.6 to 13.8)	89 (93.7; 86.2 to 97.4)

fields. Patients were then sampled from the lists using a computer-generated randomisation program.¹³ The charts of these patients were retrieved and those who had been given a local anaesthetic were enrolled. It was estimated that approximately 5% of patients who have a local anaesthetic administered in the emergency department receive bupivacaine. To be 95% sure that our sample prevalence would lie within 5% of this estimate, a sample of at least 76 patients (in total) was required.

An explicit chart review was undertaken on all enrolled patients using a data extraction document designed for the study. It was trialled and revised before use. Data were collected on patient demographics, indication for local anaesthetic, local anaesthetic used and its administration, and factors potentially effecting the choice of local anaesthetic (eg, known allergy, cardiac condition). One researcher (JJS) undertook all data extraction. A separate investigator (DT) checked a random sample of 10% of charts and data extraction documents, and found data extraction to be accurate.

Two emergency physicians (DT, JK) reviewed the final dataset together. For each patient, a determination was made as to whether bupivacaine would have been a more appropriate, less appropriate or an equivalent local anaesthetic to the one that had been administered. Factors considered in this determination were known local anaesthetic allergy and cardiac conditions, the mode of local anaesthetic administration (infiltration, nerve block, intravenous) and whether prolonged anaesthesia would have been advantageous. This determination was deliberately conservative, and unless bupivacaine was considered to confer a clear advantage, it was not classified as "more appropriate".

Consultants and registrars working in the two emergency departments participated in the cross-sectional survey. This used a self-administered questionnaire designed specifically for the study, which was examined for readability and face validity, and was trialled and revised before use. Data collected were the doctors' knowledge of lignocaine and bupivacaine, their preferences for these agents in a range of given clinical scenarios, and the perceived barriers to the use of bupivacaine. A convenience sample of doctors was used. Questionnaires were completed during meetings or distributed in the emergency department mailboxes. The survey was voluntary and anonymous. All data were reported in summary, descriptive format. No comparison between the participating emergency departments was planned or made.

RESULTS

Of 495 medical charts reviewed (approximately half from each site), 400 patients were excluded: 187 (46.8%) did not require local anaesthetic, 100 (25%) charts had incomplete documentation, 97 (24.3%) were ultimately treated elsewhere (eg, operating theatre) and 16 (4%) were excluded for other reasons. The remaining 95 patients (19.2%) comprised the final dataset. Their mean (SD) age was 39 (17) years, 67 (70.5%) were men, and no patient had a drug allergy or cardiac condition.

Table 1 shows that most injuries were lacerations and were sustained to the hand or wrist. Table 2 describes the local anaesthetic used and the nature of the administration. Lignocaine was used for 88 (92.6%) patients and was combined with epinephrine in 25 (28.4%) of these cases. It was used mainly for wound infiltration (82.3%), but for digital nerve block in 9 (9.5%) cases. Prilocaine was used for all Bier's blocks and once for a digital block. Bupivacaine was used on three occasions, twice for digital blocks and once for local infiltration. No other regional nerve blocks were performed.

Table 3 describes the appropriateness of the local anaesthetic administered in relation to bupivacaine. In most cases bupivacaine was considered to be equivalent to the local anaesthetic used and only considered less appropriate when prilocaine was used for Bier's blocks. However, there were four cases where bupivacaine was considered more appropriate. These cases were each likely to be associated with considerable prolonged pain after the effects of lignocaine had worn off. Additionally, at least for the three finger injuries, the use of epinephrine to prolong the action of lignocaine for the digital blocks administered was contraindicated.

Table 2 Nature of administration and the type of local anaesthetics administered

LA administered	Nature of LA administration, n					Total, n (%; 95% CI)
	Wound infiltration	Digital nerve block	Bier's block	Other	Not recorded	
Lignocaine (1%)	33	5	0	0	0	38 (40.0; 30.2 to 50.6)
Lignocaine (2%)	19	2	0	0	0	21 (22.1; 14.5 to 32.0)
Lignocaine (?%*)	1	0	0	0	1	2 (2.1; 0.4 to 8.1)
Lignocaine (1%)/epinephrine	13	0	0	0	0	13 (13.7; 7.7 to 22.6)
Lignocaine (2%)/epinephrine	2	0	0	0	0	2 (2.1; 0.4 to 8.1)
Lignocaine (?%*)/epinephrine	10	0	0	0	0	10 (10.5; 5.4 to 18.9)
Prilocaine (0.5%)	0	1	4	0	0	5 (5.3; 2.0 to 12.4)
Bupivacaine (0.5%)	1	1	0	0	0	2 (2.1; 0.4 to 8.1)
Other	0	0	0	2†	0	2 (2.1; 0.4 to 8.1)
Total	79	9	4	2	1	95 (100)
(%, 95% CI)	(83.2; 73.8 to 89.8)	(9.5; 4.7 to 17.7)	(4.2; 1.4 to 11.0)	(2.1; 0.4 to 8.1)	(1.1; 0.1 to 6.6)	

LA, local anaesthetic.

?%*, percentage not recorded.

†Lignocaine 2% and bupivacaine were used for digital nerve block (1 patient), 1% and 2% lignocaine were used for infiltration and digital nerve block (1 patient).

Table 3 Appropriateness of bupivacaine compared with the local anaesthetic used

Appropriateness	n (%; 95% CI)
Bupivacaine contraindicated	0 (0; 0.1 to 4.8)
Bupivacaine less appropriate than LA used	4* (4.2; 1.4 to 11.0)
Bupivacaine equivalent to the LA used	87 (91.6; 83.6 to 96.0)
Bupivacaine more appropriate than LA used	4† (4.2; 1.4 to 11.0)
Total	95 100%

LA, local anaesthetic.

*Bier's blocks.

†Fractured head of fourth and fifth metacarpal (1 patient); fracture at metacarpophalangeal joint with mild angulation (1); full thickness skin square removed from hand, dirty wound (1); almost complete amputation at level of thumb nail bed (1).

Of the 34 survey questionnaires distributed, 30 (88.2%) doctors responded. Of these, 21 (70%) were consultants, 9 (30.0%) were registrars, and all except 3 (10%) had more than 4 years of emergency department experience. Table 4 describes the responses to questions designed to assess local anaesthetic knowledge. Knowledge of these agents was variable. All but one respondent knew that bupivacaine has a longer duration of action. Other questions were less well answered. In particular, two thirds did not identify lignocaine as more painful on injection and one third did not identify bupivacaine as more cardiotoxic.

Table 5 describes the doctors' local anaesthetic preference in five given clinical scenarios. Lignocaine was clearly preferred for wound infiltration and digital block for laceration repair. However, bupivacaine was just as popular for digital block for crushing injuries. There was a greater spread of preference for local anaesthetic use in Bier's blocks. Most preferred prilocaine although one sixth of respondents preferred bupivacaine and a slightly smaller proportion preferred lignocaine.

The doctors were asked to estimate the proportions of occasions on which they used the local anaesthetic available. Of the 27 who correctly completed the questionnaire, the mean estimated proportional usage for lignocaine, bupivacaine and prilocaine were 82.6%, 12.8% and 4.6%, respectively. However, a review of both emergency departments' pharmacy records showed that the proportions of ampoules of these agents that were ordered in 2004–5 were 89.7%, 6% and 4.3%, respectively.

Table 6 describes the doctors' perceived barriers for bupivacaine use. They were asked to select one or more items from a list of potential barriers provided in the questionnaire. Clinical barriers (toxicity, onset time and duration of activity) were common responses and preference may also have related to the drug's clinical characteristics. However, non-clinical barriers (habit, cost, availability and familiarity) were also commonly reported.

DISCUSSION

In this study, lignocaine was clearly the preferred local anaesthetic in most cases, especially for wound infiltration where it was used in all but one case. This finding is consistent

with that of the survey where all respondents nominated lignocaine as the preferred local anaesthetic for wound infiltration. Lignocaine was also used for most digital nerve blocks performed. Again, this is consistent with the survey where all but one respondent nominated lignocaine as the preferred local anaesthetic for finger block before laceration repair.

It is likely that, for the large majority of patients, the use of lignocaine was quite appropriate. However, there were four (4.2%) patients for whom the use of bupivacaine might have been superior to lignocaine. Each of these patients had hand injuries associated with either bony injury and/or extensive dirty wounds. Accordingly, the prolonged duration of action of bupivacaine may have provided extended anaesthesia and optimised patient care. Therefore it is likely that bupivacaine is underused, at least for a small proportion of patients. This conclusion is supported by the finding in the doctors' survey that fewer than one half of respondents would use bupivacaine for digital finger block for a crush injury, an injury likely to be associated with prolonged pain. This is despite reports that bupivacaine is more likely to provide more complete anaesthesia than lignocaine when used for digital blocks.⁸

Interestingly, prilocaine was used on one occasion for wound infiltration. Although it can be used in this manner,^{3,14} the reasons why it was chosen ahead of either lignocaine or bupivacaine are not known. In all other cases, prilocaine was used for Bier's blocks. This agent is particularly useful for intravenous regional anaesthesia,^{14–16} where its safety profile is superior to that of lignocaine^{15,17} and where the use of bupivacaine is contraindicated.^{7,16} In this regard, the survey findings are of concern, with almost one third of respondents preferring either lignocaine or bupivacaine for Bier's blocks.

No other regional nerve blocks were performed on the patients in the study sample. This is not surprising as such blocks are performed much less commonly than the other types of local anaesthesia examined. The typical indication for a femoral nerve block is fracture of the femur,¹⁸ a condition where a long-acting local anaesthetic would be advantageous. Indeed, the survey indicated that all respondents would choose bupivacaine for femoral nerve block. Interestingly, two preferred to combine bupivacaine with lignocaine. Although these may represent attempts to provide a block with rapid onset and long duration, such use may offer little advantage, at least in finger blocks.¹⁹

Other survey results are of interest. The large majority correctly identified lignocaine and bupivacaine as having faster onset³ and longer duration,^{1,5,7} respectively. However, knowledge of other local anaesthetic characteristics was not as sound. In particular, many respondents were not aware that lignocaine may be more painful on injection^{3,6} and that bupivacaine is more cardiotoxic.^{7,10,11} These findings suggest that education initiatives are indicated to improve local anaesthetic knowledge.

The respondents estimated that they would administer bupivacaine in almost 13% of cases where a local anaesthetic was required. This estimate is likely to be an overestimate as

Table 4 Emergency department doctors' response to questions regarding the nature of local anaesthetics (n = 30)

	Lignocaine, n (%; 95% CI)	Bupivacaine; n (%; 95% CI)	No difference, n (%; 95% CI)	Not sure, n (%; 95% CI)
Which drug has the faster onset?	24* (80.0; 60.9 to 91.6)	0 (0.0; 0.3 to 14.1)	4 (13.3; 4.4 to 31.6)	2 (6.7; 1.2 to 23.5)
Which drug has the longer duration?	1 (3.3; 0.2 to 19.1)	29* (96.7; 81 to 99.8)	0 (0.0; 0.3 to 14.1)	0 (0.0; 0.3 to 14.1)
Which drug is more painful on injection?	10* (33.3; 18 to 52.9)	1 (3.3; 0.2 to 19.1)	8 (26.7; 13 to 46.2)	11 (36.7; 20.5 to 56.1)
Which drug is more cardiotoxic?	6 (20.0; 8.4 to 39.1)	20* (66.7; 47.1 to 82.1)	1 (3.3; 0.2 to 19.1)	3 (10.0; 2.6 to 27.7)

*Correct answer.

Table 5 The choice of local anaesthetics in five clinical scenarios

Clinical scenario	Lignocaine n (%; 95% CI)	Bupivacaine n (%; 95% CI)	Other n (%; 95% CI)
Local infiltration of a wound	30 (100; 85.9 to 99.7)	0 (0; 0.3 to 14.1)	0 (0; 0.3 to 14.1)
Digital finger block for a crush injury	15 (50; 31.7 to 68.3)	14 (46.7; 28.8 to 65.4)	1* (3.3; 0.2 to 19.1)
Digital finger block for laceration	29 (96.7; 81 to 99.8)	1 (3.3; 0.2 to 19.1)	0 (0; 0.3 to 14.1)
Bier's block	4 (13.3; 4.4 to 31.6)	5 (16.7; 6.3 to 35.5)	21† (70; 50.4 to 84.6)
Femoral nerve block	0 (0%; 0.3 to 14.1)	28 (93.3; 76.5 to 98.8)	2‡ (6.7; 1.2 to 23.5)

*"Wouldn't use unless I was repairing".

†Prilocaine as the alternative.

‡Preferred a combination of bupivacaine and lignocaine.

there is an apparent disparity between this "intention to use" and "actual use". The chart review indicated that only 3.2% of patients were administered bupivacaine, and the pharmacy records indicated that bupivacaine ampoules represented only 6% of all local anaesthetic ampoules ordered. However, comparisons of patient proportions and ampoule proportions are inherently inaccurate and should be interpreted with care. Notwithstanding, these findings taken together suggest that, although the respondents believed they are administering bupivacaine to a considerable proportion of their patients, this may not in fact be happening.

Interestingly, a number of non-clinical barriers to bupivacaine use were reported. Indeed, the response of "habit of using an alternative drug" was the most commonly reported barrier. The importance of this finding lies in the opportunities for change of practice through education in evidence-based practice management. This study has found that although bupivacaine may be underused for some patients the reasons for this underusage are not always evidence based. Indeed, such factors as habit, availability and knowledge of bupivacaine are all amenable to change and, consequently, better patient care may result.

This study has a number of important limitations. Although adequately powered to examine the patterns of local anaesthetic use overall, the sample size precluded in-depth examination of infrequently used local anaesthetic. Despite a high participation rate, the number of doctors surveyed was moderate and, although two emergency departments were surveyed, external validity may be questionable. Despite the consistency of the findings of the chart review and survey, it is unlikely that the doctors who managed the patients in the chart review were the same as those surveyed. Hence, the comparisons made should be interpreted with care.

The method of patient selection precluded the enrolment of some patients who were administered local anaesthetic for a range of uncommon procedures—for example, intercostal drain insertion and femoral nerve block. It is possible that bupiva-

caine may have been used more frequently than the results suggest. However, the search strategy was deliberate, as an important aim was to determine if bupivacaine is underused in common clinical scenarios.

The determination of appropriateness of bupivacaine use was subjective. It is difficult to make an accurate determination retrospectively without access to the patient and wound. This was understood from the outset of the study, and as a result, the determination was deliberately conservative. It is possible that more than the four patients reported might have benefited from prolonged anaesthesia. Similarly, the proportions reported by the doctors for estimated use of each local anaesthetic are subject to inaccuracy as a result of recall bias.

Comment should be made regarding the standard of documentation in the medical charts. The poor level of documentation, especially of the procedures undertaken, resulted in a considerable number of charts being excluded from use. Although this made the final selection of our study sample frustrating and time-consuming, it is not known if this problem introduced selection bias.

CONCLUSION

The findings of this study suggest that, at least for a small proportion of patients, local anaesthetic use may not be optimum. In particular, bupivacaine may be underused. It is also apparent that some doctors have deficiencies in their knowledge of local anaesthetics. It is likely that these two findings are related in that best practice management is reliant on a sound knowledge of the available evidence. Notwithstanding this possibility, a number of non-clinical barriers to appropriate bupivacaine use were reported. We recommend that greater consideration be given to the use of bupivacaine in those circumstances where it is likely to confer a clear benefit to the patient. Such circumstances are likely to include injuries associated with enduring and considerable pain, especially where digital blocks are indicated. We also recommend that education initiatives be established to promote rational and evidence-based use of local anaesthetic in the emergency department.

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Table 6 Perceived barriers for the choice of bupivacaine in the emergency department (n = 30)

Barrier	n* (%; 95% CI)
Habit of using an alternative drug	14 (46.7; 28.8 to 65.4)
Cardiotoxicity	12 (40.0; 23.2 to 59.3)
Slower onset than alternative drugs	9 (30.0; 15.4 to 49.6)
Personal preference	7 (23.3; 10.6 to 42.7)
Longer duration of action	6 (20.0; 8.4 to 39.1)
Cost	3 (10.0; 2.6 to 27.7)
Other†	3 (10.0; 2.6 to 27.7)
Pain on injection	0 (0.0; 0.3 to 14.1)

*More than one response allowed.

†Bupivacaine is not as readily available as lignocaine in the emergency department (2 responses).

Bupivacaine is not well known to the junior doctors (1 response).

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