Adult intraosseous infusion in accident and emergency departments in the UK

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Abstract

Objective—A postal survey was conducted to gain an overview of current opinion and practice relating to intraosseous infusion in adult resuscitation in accident and emergency (A&E) departments in the UK and to use the results to generate debate in light of published and personal experience.

Methods—Questionnaires were sent to 559 departments listed in the 1996 British Association for Accident and Emergency Medicine directory. Three hundred and thirty two (59%) were returned and the 157 (28%) consultant led departments with more than 30 000 new patient attendances per year were examined.

Results—Seventy four per cent of respondents were aware that intraosseous infusion could be used in adult resuscitation, while only seven per cent used the technique. All (100%) were involved with training their medical staff and 11% said they taught the technique for use in adults. The majority of respondents were accredited in at least one of the adult resuscitation training courses.

Conclusions—Numerous references appear in the literature relating to intraosseous infusion in adult resuscitation and represent a wealth of experience. The technique is taught and used in our department in contrast with the results of this survey, which demonstrate that it is infrequently taught and used in UK A&E departments. The more widespread teaching of this technique for adult use is recommended.

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Intraosseous infusion has, for many years, provided a method of gaining circulatory access when other methods have failed or prove too time consuming, primarily in paediatric resuscitation.¹ Advanced Paediatric Life Support, Pediatric Advanced Life Support, Pre-Hospital Paediatric Life Support, and Advanced Trauma Life Support courses highlight the advantages of the technique for use in children.^{2–5} The Advanced Life Support course makes brief mention of the technique for adult use,⁶ while the Major Incident Medical Management and Support, Emergency Management of Severe Burns, Pre-Hospital Trauma Life Support, and Advanced Trauma Life Support courses offer no alternative to the operator who, for whatever reason, is unable to gain

timely venous access in a seriously ill or injured adult patient.^{5–9} The doctor so trained, in this scenario, would not, therefore, appear to be confident in the knowledge that they could rapidly and effectively gain circulatory access, using an intraosseous infusion. Despite being recommended for adult use it remains under-represented in clinical practice,^{10–15} and this is reflected in the content of the standard adult resuscitation courses.^{5–9} We believe that an intraosseous infusion can be a useful adjunct in adult resuscitation in certain circumstances. To promote debate we undertook this survey to investigate current awareness and use of the technique in UK accident and emergency (A&E) departments and discuss the results in light of the literature reviewed and personal experience.

Method

An anonymous postal questionnaire (table 1) was sent to all UK A&E departments listed in the 1996 British Association for Accident and Emergency Medicine directory. A total of 559 questionnaires were sent to the consultant in charge of departments, irrespective of size. The responses from departments with at least one full time consultant with more than 30 000 new patient attendances per year were examined for the purposes of this survey. Results are expressed as percentages and the free text responses within questions 5 and 7 have been categorised for clarity (tables 4 and 5).

Results

Of the 559 questionnaires sent, 332 (59%) were returned, and the results from the 157 (28%) consultant led departments with more than 30 000 new patient attendances per year are summarised in tables 2–6.

Discussion

The results of this survey suggest that in UK consultant led A&E departments, seeing more than 30 000 new patients per year, intraosseous infusion as a technique for use in adult resuscitation is both infrequently taught and used despite all respondents being involved with training their medical staff and nearly three quarters being aware that the technique can be used in adults (table 2). These results may reflect the individual respondents actual or perceived clinical ability at rapidly securing central, peripheral or cut down venous access, which will not necessarily be shared by colleagues, especially juniors. The level and immediacy of senior support within their particular department may also be influential.

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Table 1 Questions from the questionnaire. Responses were either tick box or free text. The questionnaire was entitled "Adult Intraosseous Infusion Postal Survey"

Questions	
1	Does your department have at least one full time consultant? yes/no
2	Does your department see less or more than 30 000 new patient attendances per year?
3	Approximately how many adult cardiac arrests does your department deal with per month? <5: 5–15: >15
4	Are you aware the IOI can be used in adult resuscitation? yes/no
5	Do you use IOI in adult resuscitation in your department? yes/no
	If not, why not? (free text response)
6	Are you involved with training your medical staff? yes/no
7	Do you teach the technique of IOI for use in adults to your medical staff? yes/no
	If not, why not (free text response)
8	If you use or teach the technique of IOI for adult use what is:
	(a) Your favoured site? (free text response)
	(b) Why? (free text response)
9	Are you an instructor, completing instructor training, or a provider in one or more of the following: ALS; ATLS; APLS; PALS; PHTLS; PHEC; MIMMS; EMSB; BASICS?

IOI = intraosseous infusion.

The majority of respondents were accredited in either Advanced Life Support, Advanced Trauma Life Support or both, with the vast majority accredited in at least one of the adult resuscitation training courses listed in the questionnaire (table 3). The standard adult resuscitation training courses commonly constitute part of a trainers training, and intraos-

Table 2 Number of answers by the respondents to the closed options of questions 3–7 and expressed as a percentage of the total number of responses examined (157)

Question	Respondents (%)	
3 How many cardiac arrests do you deal with per month?	<5	6
	5–15	56
	>15	34
4 Are you aware that IOI can be used in adults?	Yes	74
	No	24
5 Do you use IOI in adult resuscitation?	Yes	7
	No	92
6 Are you involved with training your medical staff?	Yes	100
	No	0
7 Do you teach IOI for adult use to your medical staff?	Yes	11
	No	85

IOI = intraosseous infusion.

Table 3 Number of respondents accredited as instructors or providers in the resuscitation courses listed in the questionnaire, expressed as a percentage of the total number of respondents (157)

Course	Percentage
Advanced Life Support	65
Advanced Trauma Life Support	78
Advanced Paediatric Life Support	37
Pediatric Advanced Life Support	30
Pre-Hospital Trauma Life Support	10
Pre-Hospital Emergency Care	4
Major Incident Medical Management and Support	22
Emergency Management of Severe Burns	1
British Association of Immediate Care (BASICS)	6
Advanced Life Support and Advanced Trauma Life Support	60
At least one adult course	85

Table 4 The reasons why respondents do not use intraosseous infusion in adult resuscitation (question 5, free text option). One hundred and forty four (92%) respondents said they do not use the technique and 129 gave their reasons why. The number of responses within a given category have been expressed as a percentage of the total not using the technique

Category	Percentage
Never needed it/other methods superior/satisfactory/preferable	62
Unaware it can be used in adults	8
Not recommended in current guidelines	4
Not aware of evidence to support its use in adults	3
Technically difficult/time consuming	3
Use endotracheal route if intravenous unsuccessful	2
Unreliable/unpredictable delivery	2
Intravenous access usually secured by paramedics, if not, secured in A&E	1
No kit available	1
"No special reasons"	1
Lack of adult experience	1
No reason stated	10

seous infusion is largely untaught on these courses. The Advanced Life Support course briefly mentions intraosseous infusion after discussing endobronchial drug delivery.⁶ The Advanced Trauma Life Support course discourages use in those over 6 years old and the Pre-hospital Trauma Life Support, Major Incident Medical Management and Support, and Emergency Management of Severe Burns courses offer no alternative to intravenous access in adult resuscitation.^{5–9} The implicit assumption in Advanced Trauma Life Support teaching and other courses founded upon its principles is that intravenous access can be achieved, by the suggested techniques, in a timely manner; this, however, is not always the case. An intraosseous infusion in such circumstances could provide a temporary alternative, and a review of the literature supporting the Advanced Trauma Life Support course shock/vascular access sections found no reference to adult intraosseous infusion. The low frequency of use and teaching of intraosseous infusion for adult resuscitation, highlighted by this survey, may, therefore, also reflect the current content of the standard adult resuscitation training courses.

Contemporary adult medical and trauma resuscitation training therefore seems to fail to offer the adult any of the potential advantages of drugs or fluids administered via the intraosseous route.

Numerous reasons have been put forward for not attempting an intraosseous infusion in adult resuscitation and tables 4 and 5 show the respondents' reasons for not using or teaching the technique. As with our own experience, we would assume that most respondents, but not necessarily their juniors, are capable of rapidly securing central, peripheral, or cut down venous access and this is reflected by the top listed category in tables 4 and 5. The question to be answered, however, relates to the time taken to secure this access and whether or not a patient may benefit from drugs, initiation of a fluid infusion or marrow analysis (for example, blood typing), before venous access is achieved. We believe that when patients fall into this category, albeit infrequently, then an intraosseous infusion should be used, until definitive venous access is secured.

Table 5 The reasons why the respondents do not teach adult intraosseous infusion (question 7, free text option). One hundred and thirty four respondents (85%) said they do not teach the technique and 110 gave their reasons why. The number of responses within a given category have been expressed as a percentage of the total not teaching the technique

Category	Percentage
Not needed/not necessary/other techniques preferable	36
Not in guidelines/accepted practice	15
Not aware it can be used in adults	12
Would like to see more evidence to support its use	5
Do not teach, but mention that it could be used for adults	4
Technically too difficult	3
Unreliable/unpredictable	3
Used by seniors only	3
Lack of kit or experience	1
No reason stated	18

Table 6 The favoured sites of those who used intraosseous infusion in adult resuscitation. Only 11 (7%) of the 157 respondents used the technique, therefore numbers of respondents have been used instead of percentages. The reasons why these sites were preferred were given as; ease of access, familiarity, effective and safety

Site	No
Tibia*	9
Medial malleolus	1
Tibia and ASIS†	1

*Of the respondents, one would consider the clavicle as an alternative route and one would not be happy to use the clavicle or sternum, but would if all else failed.

†ASIS = anterior superior iliac spine.

Studies have shown that an intraosseous infusion can be established, in the adult in under two minutes by hand,^{10 14} and by means of a mechanical insertion device, the bone injection gun.¹² This time frame correlates well with our personal experience using hand held needles. Flow rates of 60–100 ml/min of crystalloid, via a 15 gauge tibial intraosseous needle, have been achieved in the adult using the hydraulic pressure of a large syringe, attached to the needle by a three way tap and fed from a standard infusion bag.¹² The flow rate via an 18 gauge intraosseous needle sited in the adult ilium has been shown to exceed that of a 16 gauge cannula inserted into the subclavian vein.¹⁰ Clearly, these flow rates do not compare with those via the preferred large bore cannulas but, nevertheless, the technique lends itself as an alternative method of initiating a fluid infusion while attempts at venous cannulation continue, in addition to providing marrow that can be used for blood grouping and other emergency analyses.

Fifty six per cent of respondents dealt with 5–15 cardiac arrests per month and 34% dealt with more than 15 per month (table 2). Many of these will be dealt with by junior staff who will not necessarily possess the skills required to perform the preferred central venous cannulation and, as would appear from the results of this survey, will not have received training in adult intraosseous infusion (table 2). The medical literature suggests that drug delivery via the intraosseous route is comparable to central and peripheral venous routes, and likely to be superior to the endobronchial delivery, in various human (adult and paediatric) and animal studies.^{4 10 14–20} Before further investigation of the

efficacy of intraosseous drug delivery to the adult circulation, a cautious extrapolation of its effectiveness based on the existing evidence might be made, to suggest that an intraosseous infusion in adult cardiac arrest could provide a simple alternative to central venous and a preferable alternative to endobronchial drug delivery. As most resuscitative drugs and fluids can be given via the intraosseous route,^{11 18} patients with life threatening sepsis, hypothermia, status asthmaticus, status epilepticus, burns, or intravenous drug users may also benefit from this method of delivery while attempts at conventional venous access continue.

All our senior house officers and middle grade medical staff are trained how and when to use an intraosseous infusion in adults as well as children. The authors' favoured intraosseous needle for adult use is all stainless steel, 3 cm long by 14 gauge, with a 45° trocar tip and side ports (Cook Critical Care). This needle is robust and rapidly penetrates the adult bone cortex with ease. A large syringe and standard infusion bag are connected to the needle via a three way tap for fluid administration; drugs can also be administered directly through the needle via the tap. Six people can be trained in 45 minutes and, despite infrequent use, proficiency is maintained (personal experience), similar has been reported among paramedics.²¹ Table 6 shows the favoured sites of the respondents for establishing an intraosseous infusion. We teach the anterior iliac crest as the first site to be considered, as this is easily accessed in a variety of scenarios including gross obesity. Numerous sites have, however, been described in the literature and include the clavicle, anterior ilium, tibia, medial and lateral malleoli, the distal radius and sternum.^{1 10 12 21–23} The olecranon and medial aspect of the calcaneum have also been used (personal communication). The rate of serious complications in adults and children is infrequent,^{1 12} the exception may be the sternal route where deaths have been attributed to mediastinitis, hydrothorax and injury to the heart and great vessels.^{1 15} Furthermore, the sternal route would appear neither practical nor safe in patients receiving cardiopulmonary resuscitation or those with significant chest trauma.

Conclusion

All respondents in this survey were involved with training their medical staff. A minority taught intraosseous infusion for adult resuscitation and even fewer used it. The dissemination of the value of this technique seems to be low among doctors working and receiving training in UK A&E departments. This may be a reflection of the trainers' training by means of the standard resuscitation training courses, the responding person's own skill level, which may not necessarily be shared by colleagues and juniors, or the level and immediacy of senior support within their particular institution.

The intraosseous delivery of drugs and fluids to the adult circulation, in patients with and without a spontaneous cardiac output, requires

further investigation. However, at present, we would recommend the technique be routinely taught to all medical students and doctors in training, especially those working in A&E departments, and that it be considered for inclusion within the remit of the standard adult resuscitation training courses.

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