EZ-IO® by vidacare
Intraosseous Infusion System

Immediate Vascular Access... When You Need It.SM

Humerus Site Identification

Proper Positioning for Use of the Proximal Humerus (Figure 1):

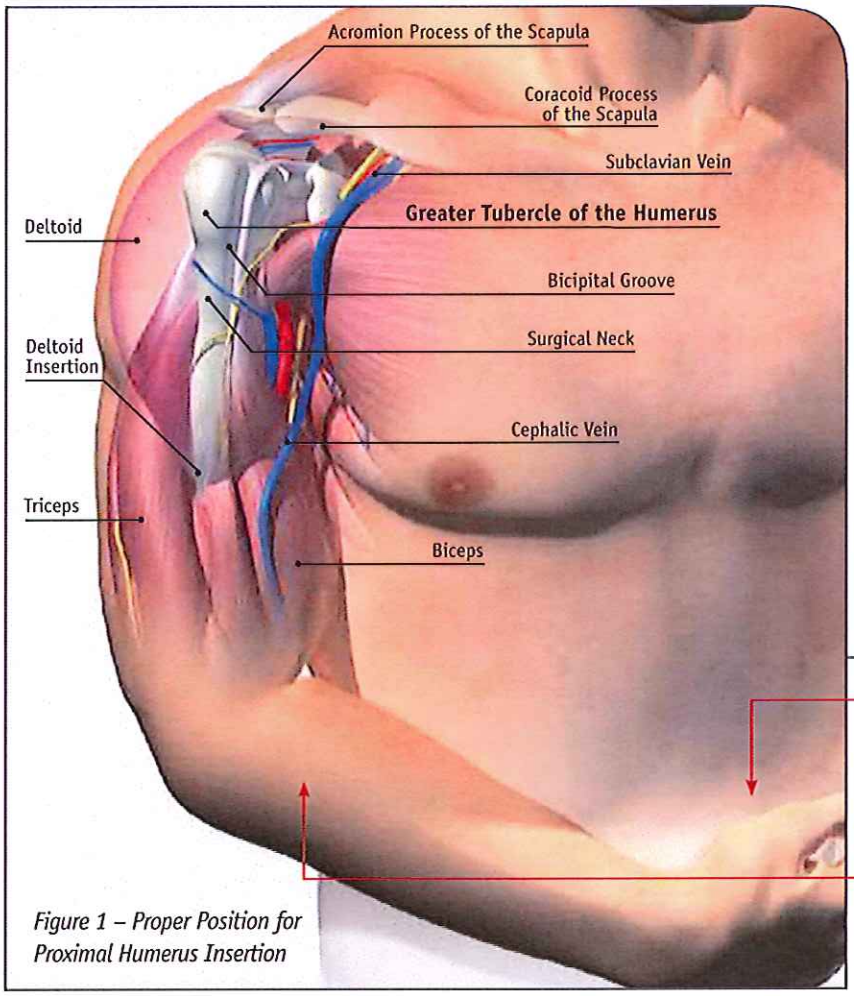


Figure 1 – Proper Position for Proximal Humerus Insertion

Place the patient's hand over the umbilicus
Causes medial rotation of elbow and humerus

Adduct the arm
Provides greater prominence of insertion site

The proximal humerus – a relatively new option for intraosseous access – provides additional benefits over the more commonly used tibial locations.†

The close proximity of the greater tubercle of the humerus to the heart ensures rapid infusion of medications into the central circulation.[i] Moreover, at least one human study suggests infusion is better tolerated by patients when compared to the tibial sites.[ii]

Despite these benefits, the anatomy of the proximal humerus region often discourages its use by clinicians. By becoming familiar with the anatomical structures, clinicians can simplify the site identification process and feel more comfortable accessing the site.

NOTE FOR SPECIAL PROCEDURES:

For situations in which the patient's hand cannot be placed over the umbilicus, such as during a surgical procedure, the clinician should ensure the humerus is fully rotated internally. This movement rotates most of the anterior structures of the region toward the axilla and shifts the greater tubercle of the humerus to a more anterior position. Adduction of the arm increases prominence of the humeral head in relation to the surface anatomy.

† This information is provided for illustrative purposes only and does not purport to be medical advice or treatment. The individual clinician is responsible for determining the proper intraosseous procedures, site(s) and technique(s) used with this device.

REFERENCES

i Hoskins S, Kramer G, Stephens C, Zachariah B. Efficacy of epinephrine delivery via the intraosseous humeral head route during CPR. *Circulation*. 2006;114:II_1204.

ii Philbeck TE (Vidacare Corporation, Shavano Park, TX, USA), Miller LJ, Montez D, Powell T. Consecutive volunteer studies of pain management and fluid administration measurement during intraosseous infusion. Poster session presented at: 2010 Scientific Assembly of the American College of Emergency Physicians; 2009 October 5-8; Boston, MA.

Humerus Site Identification (Continued)

Steps to Properly Identify the Insertion Site (Figure 2):

Identify the humerus ❶

The humerus is most easily palpated at the insertion point for the deltoid muscle, between the biceps and triceps muscles. This point is approximately mid-way along the length of the arm (see illustration). Palpation of the bone requires firm pressure due to overlying structures.

Locate surgical neck of the humerus ❷

The surgical neck can be located by palpating up the length of the humerus until the clinician feels a "notch" or "groove."

Identify insertion site ❸

The appropriate insertion site is approximately 1 cm above the surgical neck for most adults.

Insertion and Removal of Device

The insertion and removal procedure for the proximal humerus is identical as for other approved sites.

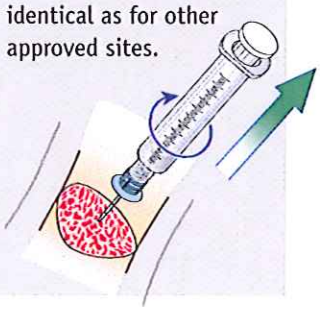
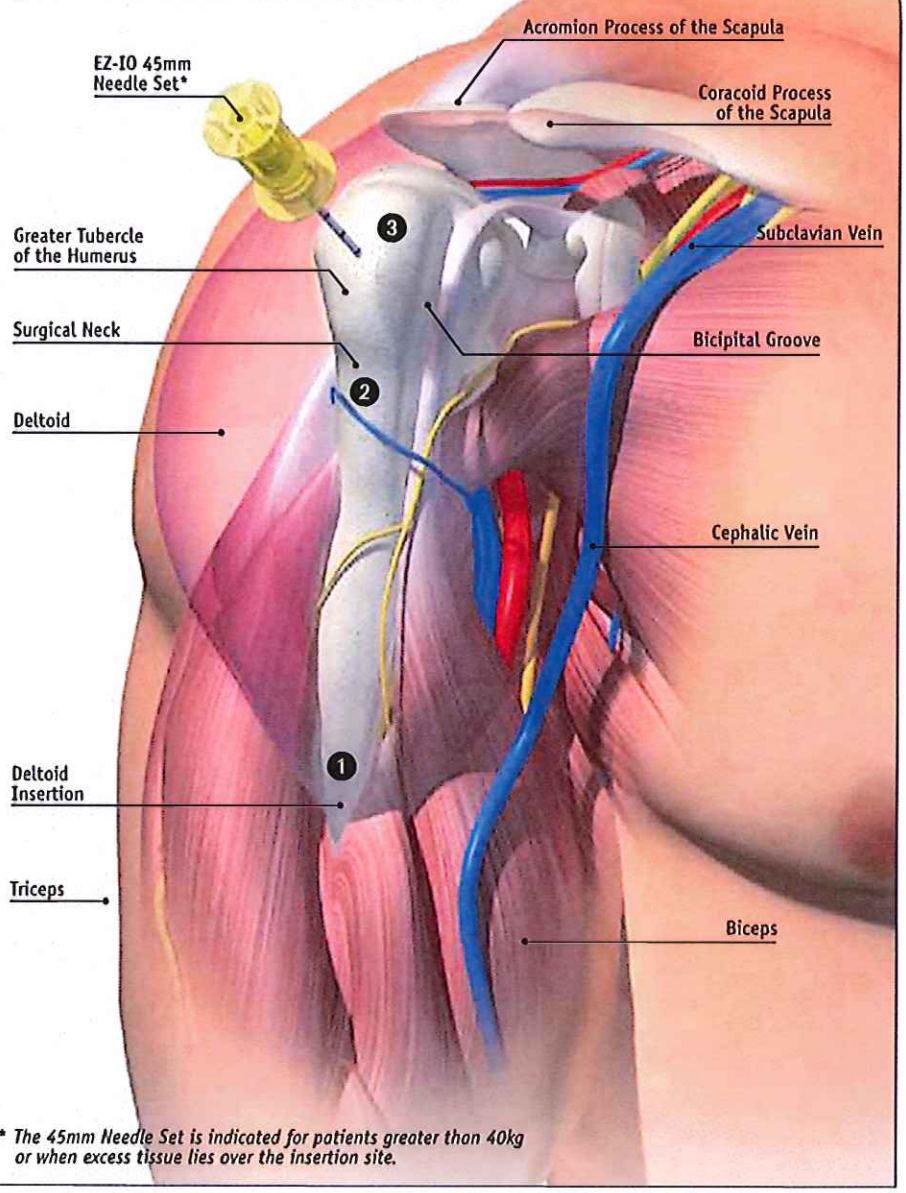


Figure 2 – EZ-IO Proximal Humerus Insertion Site



* *The 45mm Needle Set is indicated for patients greater than 40kg or when excess tissue lies over the insertion site.*

NOTE ON STABILIZATION: *Movement of the arm above the plane of the shoulder can result in needle dislodgement from impingement of the needle set on the acromion process of the scapula. Following insertion of a humeral IO device, the patient's arm should be immobilized to prevent movement above the level of the shoulders. In most cases restraint in the adducted position is preferred. The IO device itself should also be secured to prevent accidental dislodgement (the EZ-Stabilizer is designed for this purpose).*

IO Analgesia: a suggested protocol

Intraosseous administration of preservative-free lidocaine.
Read this guideline fully before use - if in doubt seek senior medical advice.

Volume of preservative-free lidocaine - *titrate IO to analgesic effect*					
Age	**Weight (kg)**	**Volume of 2% (ml) 1 ml of 2% = 20 mg/ml**		**Volume of 1% (ml) 1 ml of 1% = 10 mg/ml**	
		Initial	Subsequent	Initial	Subsequent
Neonate	3	0·07	0·03	0·15	0·07
Neonate	4	0·1	0·05	0·2	0·1
7 weeks	5	0·12	0·06	0·25	0·12
3 months	6	0·15	0·07	0·3	0·15
5 months	7	0·17	0·08	0·35	0·17
7 months	8	0·2	0·1	0·4	0·2
1 year	9	0·22	0·11	0·45	0·22
15 months	10	0·25	0·12	0·5	0·25
2 years	12	0·3	0·15	0·6	0·3
3 years	14	0·35	0·17	0·7	0·35
4 years	16	0·4	0·2	0·8	0·4
5 years	18	0·45	0·22	0·9	0·45
6 years	20	0·5	0·25	1	0·5
7 years	23	0·57	0·28	1·1	0·57
8 years	26	0·65	0·32	1·3	0·65
9 years	29	0·72	0·36	1·4	0·72
10 years	32	0·8	0·4	1·6	0·8
11 years	35	0·87	0·43	1·7	0·87
12 years	39	0·97	0·48	1·9	0·97
13 years	44	1·1	0·55	2·2	1·1
14 years	50	1·2	0·62	2·5	1·2
15 years	54	1·3	0·67	2·6	1·3
16 years	58	1·4	0·72	2·8	1·4
Adult	60	1·5	0·75	3	1·5
	70	1·7	0·87	3·4	1·7
	80+	2	1	4	2

The lower volumes of 2% lidocaine (<1 ml) may be difficult to accurately measure, and use of, or dilution to, 1% lidocaine should be considered under these circumstances. Use the appropriate syringe size for the volume to administer to ensure maximum accuracy:	**Volume**	**Syringe size**
	0 - 1 ml	1 ml
	1 - 2·5 ml	2·5 ml
	2·5 - 5 ml	5 ml

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EZ-IO and Laboratory Testing

Background

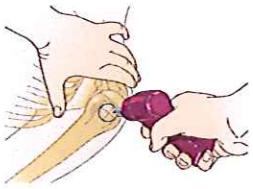
Improved vascular access devices, which enable providers to deliver critically needed drugs as quickly as central lines, have ignited a resurgence in the intraosseous (IO) route to vascular access. This, in turn, has led to other uses of the IO vasculature, including drawing IO blood for laboratory analysis.

It has been a number of years since the last published study examining IO blood for laboratory analysis.[i] For this reason, Vidacare conducted and completed this new study to both validate earlier research and address concerns regarding the use of IO-derived blood for laboratory analysis.

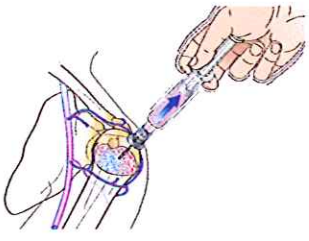
Study Methodology & Design[ii]

Ten healthy adult volunteers consented to participate in an IRB-approved study involving the following:

- Blood samples were obtained from peripheral veins in the forearm. Within 5 minutes, an IO catheter was placed in the proximal humerus.
- Two sets of IO blood samples were obtained from each participant, one set following 2 ml of marrow/ blood waste and one set following 6 ml of waste.
- All sample sets were analyzed at a reference laboratory for complete blood count and chemistry profile.
- Means were compared for each blood test from the drawn samples (Intravenous, IO-1, and IO-2), with intravenous blood values serving as controls for IO blood values.



Insertion at proximal humerus



Drawing of blood at proximal humerus

EZ-IO G3 Power Driver

RESULTS & CONCLUSIONS

Intraosseous (IO) and intravenous (IV) laboratory values had statistically significant correlation for many commonly ordered lab studies, with some exceptions as noted. (*See Table and Graphs, Page 2.*)

The intraosseous space proved to be a reliable source for blood laboratory analysis for several commonly ordered tests, such as hemoglobin and hematocrit, as well as several chemistry values.

NOTE: Results may not be reliable for CO_2 and platelets, and are unreliable for WBCs.

REFERENCES

[i] Grisham J, Hastings C. Bone marrow aspirate as an accessible and reliable source for critical laboratory studies. *Ann Emerg Med.* 1991;20:1121-1124.

[i] Hurren JS. Can blood taken from intraosseous cannulations be used for blood analysis? *Burns.* 2000;26:727-730.

[ii] Miller LJ, Philbeck TE, Montez DF, Spadaccini CJ. A new study of intraosseous blood for laboratory analysis. *Arch Pathol Lab Med* 2009;133:1628.

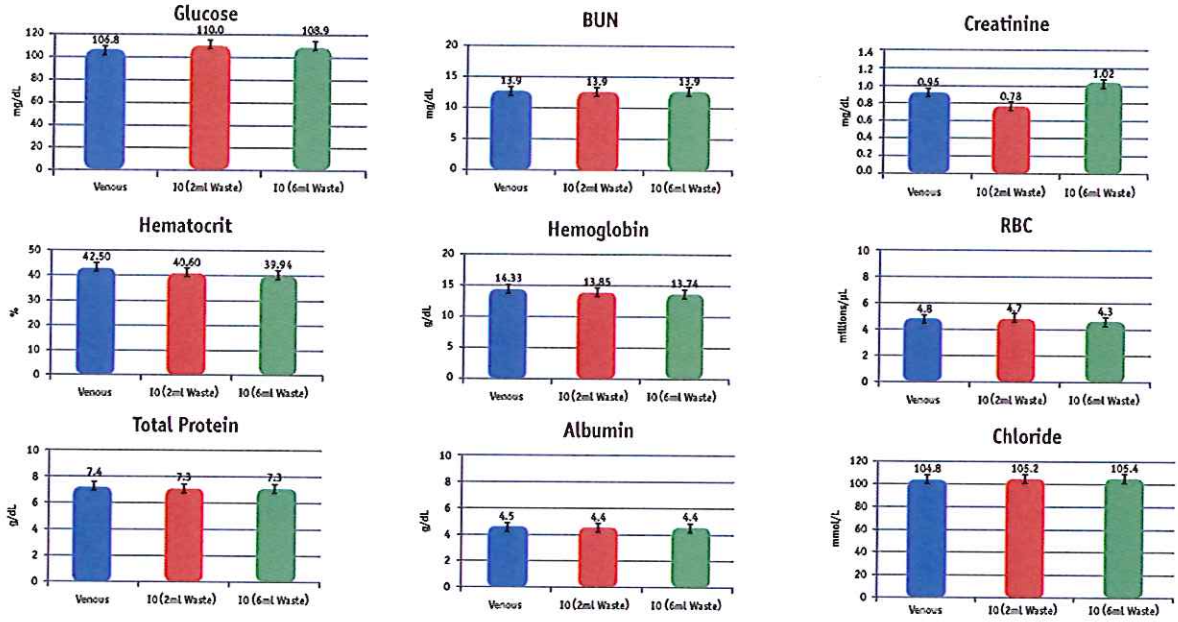
EZ-IO and Laboratory Testing (Continued)

IO vs. IV Comparisons

The graphs and table shown are comparisons of mean laboratory values by sampling method.

IV indicates the typical intravenous phlebotomy sampling. IO-1 indicates first intraosseous sampling following 2 ml of marrow/blood waste. IO-2 indicates second intraosseous sampling following 6 ml of waste.

The following lab studies produced a statistically significant correlation between IO and IV values:



Certain laboratory values did not produce a statistically significant correlation. CO_2 and platelet count were lower for IO blood than for IV blood, and WBCs were elevated in the IO samples. Potassium, sodium and calcium did not produce statistically significant correlation.

VALUE	IV	IV/IO-1 r (p VALUE)	IO-1	IV/IO-2 r (p VALUE)	IO-2	IO-1/IO-2 r (p VALUE)
WBC[1].....(1000/µL)	7.6 ± 1.6	-.193 (ns)	15.0 ± 7.1	.53 (ns)	10.4 ± 4.0	.76 (ns)
RBC[2] .....(millions/µL)	4.8 ± 0.4	.88 (.004)	4.7 ± 0.4	.99 (<.001)	4.3 ± 0.2	.99 (<.001)
Hemoglobin .... (g/dL)	14.3 ± 0.9	.91 (.002)	13.9 ± 1.6	.98 (.004)	13.7 ± 0.8	.95 (.013)
Hematocrit.....(%)	42.5 ± 2.8	.85 (.008)	40.6 ± 2.9	.91 (.031)	39.9 ± 1.7	.95 (.013)
Platelets....(1000/µL)	301.9 ± 76.0	.47 (ns)	201.7 ± 77.0	.91 (ns)	238.3 ± 34.3	-.55 (ns)
Glucose .....(mg/dL)	106.8 ± 14.4	.90 (.001)	110.0 ± 16.3	.85 (.003)	108.9 ± 15.9	.95 (<.001)
BUN[3].....(mg/dL)	13.9 ± 2.5	.98 (<.001)	13.9 ± 2.4	.98 (<.001)	13.9 ± 2.4	.98 (<.001)
Creatinine.....(mg/dL)	1.0 ± 0.2	.97 (<.001)	0.8 ± 0.2	.96 (<.001)	1.0 ± 0.2	.96 (<.001)
Sodium.....(mmol/L)	140.3 ± 3.7	.22 (ns)	136.4 ± 1.7	.13 (ns)	136.4 ± 1.5	-.23 (ns)
Potassium...(mmol/L)	4.6 ± 0.5	.38 (ns)	5.4 ± 1.0	-.13 (ns)	5.0 ± 1.0	.21 (ns)
Chloride.....(mmol/L)	104.8 ± 1.7	.81 (.009)	105.2 ± 1.4	.76 (.018)	105.4 ± 2.0	.76 (.016)
CO_2[4].....(mmol/L)	22.7 ± 3.2	.45 (ns)	17.4 ± 2.5	.64 (ns)	17.3 ± 2.1	.71 (.033)
Calcium.....(mg/dL)	9.9 ± 0.5	.08 (ns)	9.2 ± 0.3	.57 (ns)	9.2 ± 0.3	.48 (ns)
Total Protein... (g/dL)	7.4 ± 0.3	.77 (.016)	7.3 ± 0.4	.90 (.001)	7.3 ± 0.4	.89 (.001)
Albumin ..... (g/dL)	4.5 ± 0.2	.74 (.022)	4.4 ± 0.2	.89 (.001)	4.4 ± 0.3	.79 (.012)

1 - White blood cells 2 - Red blood cells 3 - Blood urea nitrogen 4 - Carbon dioxide ns = non-significant

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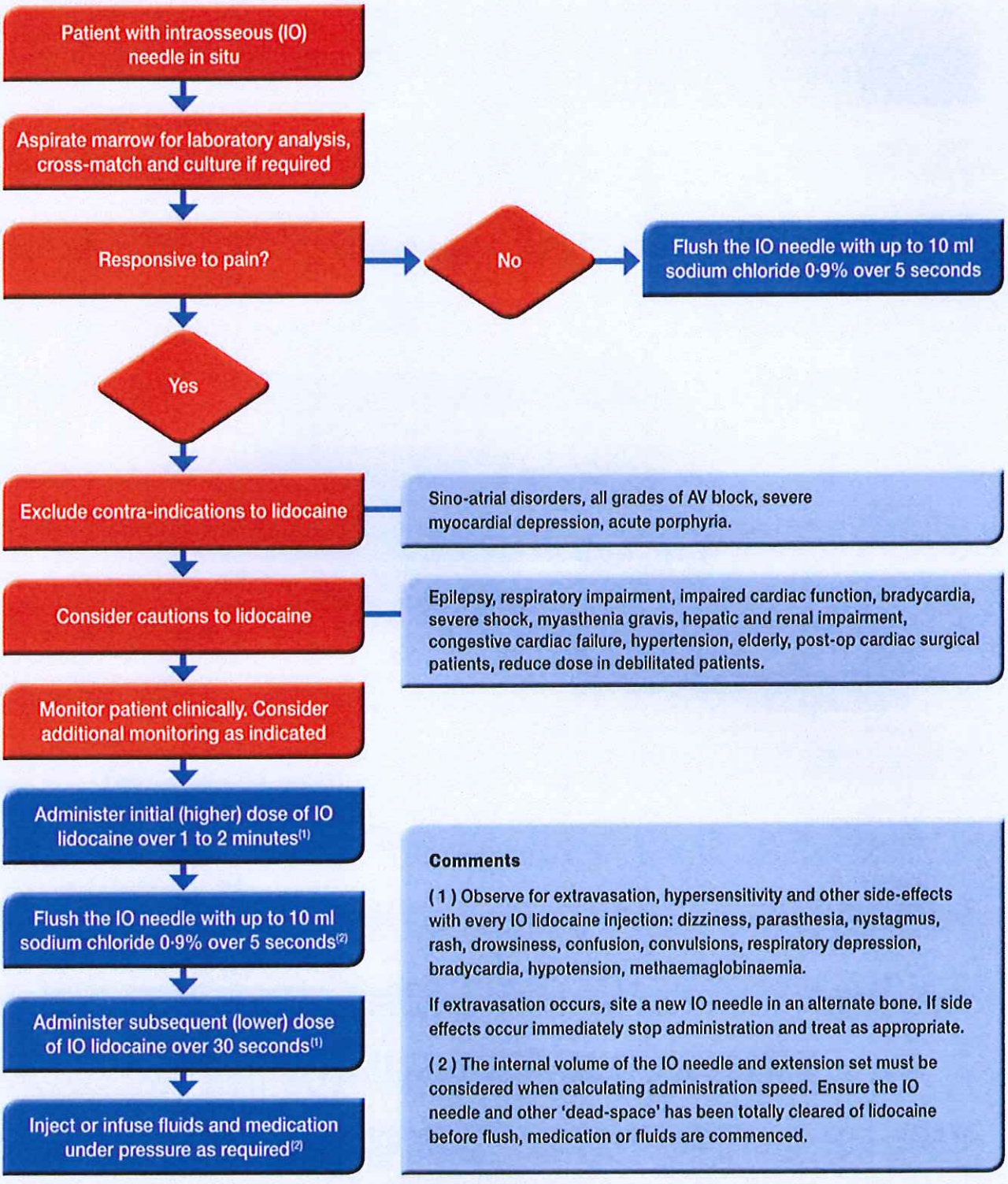

Disclaimer: Whilst every care has been taken to ensure that doses and recommendations are correct, the responsibility for final check must rest with the prescriber.