SHORT REPORT

Administering a glyceryl trinitrate infusion: big is not always best

Matthew J Reed

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With the use of some simple calculations it can be demonstrated that the choice of cannula and initial glyceryl trinitrate (GTN) infusion rate for patients with acute left ventricular failure (LVF) requires some careful thought. If a GTN infusion is commenced at a rate of 1 ml/h, a critically unwell patient with a large cannula—for example, a grey cannula—will have to wait over 6 min for the drug to enter the body. This compares with 1.5 min for a pink cannula at the same infusion rate. If a large-diameter cannula is chosen for these patients, then a fast initial infusion rate should also be chosen to ensure that the GTN begins to act quickly. The rate can later be adjusted depending on clinical conditions.

An infusion of glyceryl trinitrate (GTN) is one of the key components in the treatment of acute left ventricular failure (LVF). Patients can be extremely unwell and are therefore often managed in the emergency department resuscitation room, a place where it is not unusual for larger intravenous cannulae to be sited. The following calculation shows that the adage ''big is best'' is not always the case.

METHODS

GTN or nitrocine is available at a concentration of 1 mg/ml, and in the treatment of acute LVF is often administered undiluted via a syringe pump at a rate of 10–200 μg/min.[1] This is equivalent to 0.01–0.2 ml/min or 0.6–12.0 ml/h. This is the origin of the often quoted initial rate of infusion of 0.6 ml/h. Before starting an infusion, the GTN solution is flushed through to the end of the giving set and then connected to the intravenous cannula. The time taken for the infusion to pass through the cannula, enter the patient's vein and start its effect depends on the volume of dead space inside the cannula and the chosen initial infusion rate.

Table 1 details the characteristics of five commonly used intravenous cannulae.[2] The volume of each cannula was calculated (length multiplied by radius squared multiplied by Π) in mm^3. This was then converted to millilitres (1 ml = 1 cm^3 = 1000 mm^3, therefore 1 mm^3 = 0.001 ml). The rate of infusion in millilitres per hour was divided by 3600 to convert it to millilitres per second. The time in seconds for the infusion to pass through the dead space inside the cannula was then calculated (volume of cannula in millilitres divided by infusion rate in millilitres per second; table 2) for each of the five GTN infusion rates.

Table 1 Characteristics of five commonly used intravenous cannulae

Cannula	Gauge	Diameter (mm)	Length (mm)	Volume of cannula (mm^3)
Blue	22	0.8	25	12.6
Pink	20	1.0	32	25.1
Green	18	1.2	45	50.9
Grey	16	1.7	45	102.1
Orange	14	2.0	45	141.3

RESULTS

If a GTN infusion is started at 1 ml/h, a critically unwell patient with a large cannula—for example, a grey cannula—will have to wait over 6 min for the drug to enter the body, compared with 1.5 min for a pink cannula at the same infusion rate. Increasing the infusion rate to 5 ml/h, for example, reduces the dead space time to 74 s for a grey cannula and 18 s for a pink cannula. The larger the cannula chosen and the slower the infusion rate selected, the longer the cannula lead time before the drug becomes active.

I acknowledge that these observations are only theoretical. Once the time taken to set up a GTN infusion and start other treatments, such as non-invasive ventilation, is taken into account, it is difficult to know how much the choice of cannula size actually contributes to patient outcome. As a recommendation for everyday practice, however, choice of cannula size and initial infusion rate may be worth more thought.

CONCLUSION

In critically unwell patients with acute LVF, if a bigger cannula is chosen then a high initial infusion rate should also be chosen

Abbreviations: GTN, glyceryl trinitrate; LVF, left ventricular failure

Table 2 Time in minutes and seconds for the glyceryl trinitrate infusion to pass through the dead space inside the cannula at different rates of infusion (0.6, 1.0, 2.0, 5.0 and 12.0 ml/h)

Cannula	0.6	1.0	2.0	5.0	12.0
Blue	1 min, 15 s	0 min, 45 s	23 s	9 s	4 s
Pink	2 min, 31 s	1 min, 30 s	45 s	18 s	8 s
Green	5 min, 5 s	3 min, 3 s	1 min, 32 s	37 s	15 s
Grey	10 min, 13 s	6 min, 8 s	3 min, 4 s	1 min, 14 s	31 s
Orange	14 min, 8 s	8 min, 29 s	4 min, 14 s	1 min, 42 s	42 s

to ensure that the GTN begins to act quickly. Once the drug has passed through the cannula, the rate of administration should be adjusted depending on the clinical condition of the patient and blood pressure constraints.

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Correspondence to: Dr M J Reed, Department of Emergency Medicine, Royal Infirmary of Edinburgh, 51 Little France Crescent, Edinburgh EH16 4SA, UK; mattreed1@hotmail.com

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