Title: Valsalva using a syringe: pressure and variation

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ABSTRACT

Introduction: The Valsalva manoeuvre is commonly used in emergency departments to terminate supraventricular tachycardia by the patient blowing into a syringe.

Aim: To identify the pressures required for different syringe sizes.

Results: 20% of syringes “stuck” and required high pressures to move. In the remaining 80% of syringes a 20ml syringe was the most appropriate size to achieve the recommended 40mmHg. Once “released” plunger position did not make a difference.

Conclusion: If consistent pressures are required, we recommend using a manometer rather than a syringe.

INTRODUCTION

The Valsalva manoeuvre (VM), first identified in 1704,[1] is still used in emergency departments as a non-pharmacological method for terminating haemodynamically stable supraventricular tachycardia (SVT).[2] The manoeuvre involves expiring against a closed glottis to increase intrathoracic pressure, triggering baroreceptor activity and increased vagal tone. It is believed to be safe, despite various theoretical complications.[3] Blowing into a syringe is a simple method for realising VM. Other methods include blowing against the thumb in the mouth, bearing down and pushing against a hand on the abdomen.[4]

A standard suggested technique for the VM, based on physiological studies, requires a duration of 15 seconds and a pressure of 40mmHg in a supine posture.[5] However, this is rarely followed.[6] Documented success rates range from around 5-55%.[7-9] A modified VM technique involving a passive leg raise (and generating pressure by blowing into a manometer) has recently been shown to more than double success rate (43% v 17%).[9]

A commonly used, practical method to achieve the VM is to ask the patient to blow into the end of a syringe hard enough to move the plunger. Smith et al found that a 10ml syringe produced the required pressures.[4] We aim to test pressures required for different syringe sizes and plunger positions.

METHODS

We compared 20 syringes each of 5ml (BD Emerald), 10ml (BD Emerald) and 20ml (BD Plastipak) using an IDASS manual sphygmomanometer (lower limit: 0mmHg, upper limit: 300mmHg, 2mmHg increments). Each syringe was removed from its sealed packet and the manometer tubing directly attached to the syringe without altering the plunger position (PICTURE 1).

Manometer pressure was increased gradually and recorded at first sign of plunger movement (two observers). The pressure was released and the plunger was manually moved to $\frac{1}{4}$ of the volume of the syringe (i.e. 5mL for a 20mL syringe). The pressure required to move the plunger was recorded and the process repeated for $\frac{1}{2}$ and $\frac{3}{4}$ of the syringe volume. Finally, the plunger was moved back to the zero mark and the test repeated, because we had observed in practice that syringes can become 'stuck' when used straight from the packet.

Data was tested for normality and the median and interquartile range for each syringe type was calculated.

RESULTS

Table 1: median pressures required to move plunger

	Median pressure (mmHg) and interquartile range				
	New syringe	$\frac{1}{4}$	$\frac{1}{2}$	$\frac{3}{4}$	0
5ml	167 (160-179)	58 (48-62)	55 (44-69)	60 (53-65)	84 (68-102)
10ml	147 (138-152)	76 (64-84)	77 (59-97)	81 (69-99)	79 (73-86)
20ml	>300	52 (42-64)	45 (40-61)	48 (41-57)	42 (36-53)

All syringes required very high pressures if the plunger had not been previously moved (Table 1). Once the plunger had been moved, the larger the syringe, the lower the pressure required.

20% of syringes “stuck” and required high pressure to move at all points (Figure 1). Apart from these outliers, a 10ml syringe required >70mmHg and a 20ml syringe required 40-50mmHg (Figure 2).

LIMITATIONS

Our results may not be generalizable as we tested only two models from one brand of syringes. Other departments may use different brands. For practical reasons, we were not blinded to the size of syringe and were aware of required pressure. However the person observing plunger movement was not aware of the manometer dial. Blinding would not affect the fact that some plungers could not be moved. We used a manometer bulb to create pressures. This is likely to create a different pressure pattern from a patient blowing into the syringe, so is less realistic but allows for greater experimental control.

DISCUSSION An important finding is that about 1 in 5 syringes “stick”, perhaps due to small manufacturing irregularities. This will not have an effect on the intended use of the syringe, however even small irregularities may become important when syringes are used at these relatively low pressures.

It is impossible to blow hard enough to move the plunger straight out of the packet, so it is important to “release” the plunger before use. Once “released”, plunger position did not greatly affect the pressures, but we note that moving it to halfway allows the patient to see the plunger moving.

Our results are different from the previous study,[4] suggesting that the specific make of syringe may be important. In our department, a 20ml syringe is most likely to provide the recommended 40mmHg. This implies that emergency physicians should know the characteristics of their local syringe types and be aware that suppliers may change.

CONCLUSION

There is little evidence about the optimal pressure for SVT termination. However, our results suggest that if it is important to accurately create a pressure of 40mmHg, the patient should blow into a manometer rather than a syringe.

COMPETING INTERESTS

None

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LEGENDS FOR FIGURES

Figure 1: Pressures for 20ml syringes (4 outliers)

Figure 2: Median pressures for 10ml and 20ml syringes with interquartile range

Picture 1: Attachment of the syringe to the manometer