

## The VAR Is Positional Sensitive

The VORTRAN Automatic Resuscitators (VAR™) will function in any position as long as the adjustments are made in a secured position (strapped or taped to the patient). Tilting movements of less than 45° have no significant effect on the PIP setting. The working mechanism of the VAR consists of a moving piston or diaphragm which has mass (weight). The mass adds an additional spring force or a subtraction of spring force when the VAR is positioned with the modulator vertically up or vertically down. If the VAR is moved from a horizontal to a vertical position, the addition or subtraction of spring force will affect the PIP setting by 1 to 3 cm-H<sub>2</sub>O. The positional effect on PIP is an educational and training issue.<sup>[1]-[2]</sup> The VAR will function in any position as long as the final adjustments are made in its secured position.

### INTRODUCTION

The VORTRAN Automatic Resuscitators (VAR™) are pneumatically driven, flow controlled devices unlike the conventional electro mechanical ventilators. The VAR modulator functions like a piston or a diaphragm system which cycles at PIP and PEEP. The cycling thresholds are controlled by a spring force on the piston or diaphragm. Because the piston, diaphragm and spring have mass, the position of the modulator, relative to the vertical direction, causes an increase or a decrease in the set PIP setting as the modulator is rotated. Because of this effect, final adjustments to the VAR's modulator should be made in the restrained position. However, it is of interest to know how much the set PIP pressure changes as the modulator is rotated.

### METHODS

Three each of the VAR-Plus (PCM-5011) and VAR (RCM-4011) from the production lots were selected for bench top evaluation using the Test and Training Lung (TTL, Model 3600i, by Michigan Instruments, Inc.) with PneuView Software. Each device was

setup initially with the modulator in the vertical up position (Fig-2) with the I/E ratio set to approximately 1:2. The PIP data was recorded. The device was then rotated to position the modulator horizontally (Fig-1), and the resulting PIP was recorded. The modulator was then turned to the down position (Fig-3), and the final PIP was recorded.

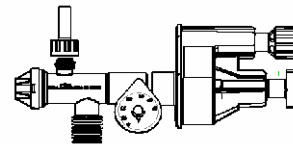


Figure 1

Modulator in the horizontal position

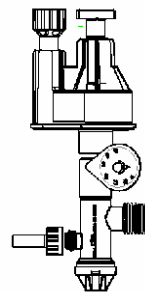


Figure 2  
Set PIP with  
Modulator in the  
vertically up  
position

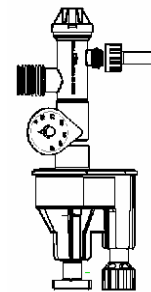


Figure 3  
Rotate Modulator  
to vertically down  
position

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The initial PIP targets, with the modulator in the vertical up position, were 45, 40, 35, 30, 25, 20, 15 and 10 cm-H<sub>2</sub>O for the VAR-Plus and 45, 40, 35, 30, 25 and 20 cm-H<sub>2</sub>O, for the VAR-RCM. This yielded a matrix of PIP and PEEP values from which the pressure change from the horizontal position could be calculated.

**RESULTS**

Table 1 – Results of VAR-Plus Set PIP

Device	PIP with Modulator positioned horizontally	PIP increase Modulator in the vertically up position	PIP decrease Modulator in vertically down position
VAR-Plus (PCM)	44	1.1	-1.1
	39	1.0	-1.0
	34	1.2	-0.9
	29	1.1	-0.8
	24	1.1	-0.9
	19	1.1	-0.9
	14	1.0	-1.0
	9	0.8	-1.0
	AVG	1.0	0.9
VAR (RCM)	43	2.1	-3.1
	38	2.2	-3.0
	33	2.7	-2.9
	28	2.4	-2.9
	23	2.6	-2.7
	18	2.6	-3.0
	AVG	2.4	-2.9

The averaged PIP for the horizontal position are listed in Table 1. The changes in pressure when the device is rotated from vertically up and to vertically down are calculated from PIP recordings, and the results illustrate the gravitational effect on the modulator components and the resultant effect. Table 1 show that the VAR-RCM does have PIP change effects of up to 3.1 cm-H<sub>2</sub>O when the

device is rotated from horizontal up or down. The VAR-Plus exhibits significantly less positional sensitivity with a change of up to 1.1 cm-H<sub>2</sub>O. This is a result of the improved diaphragm modulator design.

**CONCLUSIONS**

Although the VAR experiences PIP setting changes of 1 to 3 cm-H<sub>2</sub>O when the device is moved, the impact should be significantly less than the inconsistencies that occur during manual resuscitation with a Bag-Valve-Mask (BVM).<sup>[3]-[4]</sup> The positional effect on PIP is an educational and training issue.<sup>[1]-[2]</sup> Users need to know that the VAR will function in any position, as long as final adjustments to the device are made after it has been positioned securely. The manufacturer of the VAR is continuing to improve the design and function of the VAR and is making every effort to reduce the changes in the PIP setting.

**REFERENCES**

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