Peripheral Venous Pressure and Venous Return Pressure

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IN SPITE of its clear-cut explanation, the graphical analysis of the circulation proposed by Guyton¹ with the new concept of mean circulatory filling pressure (Pms) has not generally been approved in the clinical field. This is mainly because the measurement of Pms is practically impossible in patients. In this paper, the possibility to use peripheral venous pressure (PVP) instead of Pms, and the nature of venous return pressure (ΔP) which was defined as PVP - central venous pressure (CVP) were investigated aiming at the clinical application of this analysis technique for the post-operative care of cardiovascular patients.

METHODS

PVP was measured in the medial great saphenous vein at the level of knee joint in 7 mongrel dogs using calibrated pressure transducers. One hundred and twenty-five measurements were performed in 26 patients who had open heart surgery in this institute. Both venous pressures were measured hydrostatically and a branch of the great saphenous vein on the dorsum of foot was selected for the measurement of PVP. Catheter tips were always pointed to the proximal side of the body. Zero point was referred to the physiological reference point for the dogs by Guyton and Greganti², and to the

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TABLE I

Exp.	CVP (mmHg)	PVP (mmHg)	ΔP (mmHg)
1	-0.7 (-0.2)	7.0 (5.5)	7.7 (5.7)
2	-0.5 (0)	3.0 (3.3)	3.5 (3.3)
3	-0.5 (0.5)	2.5 (3.0)	3.0 (2.5)
4	-0.5 (1.5)	3.3 (3.0)	3.8 (1.5)
5	-1.5 (-1.0)	2.0 (0)	3.5 (1.0)
6	-2.5 (-1.0)	7.5 (5.0)	10.0 (6.0)
7	-2.0 (-1.5)	1.0 (0.5)	3.0 (2.0)

$\Delta P = PVP - CVP$ (): open chest

TABLE II

	CVP	PVP	ΔP
Hypovolemia	↓	↓	—↑
Hypervolemia	↑	↑	—↓
Right heart failure	↑	—↑	↓
Left heart failure	—↓	↓	↓

—↑ : not changed or slightly increased, v.v..

anterior axillary line at the manubriosternal joint for the post-operative patients in supine position.

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RESULTS

Measurements in the dogs were shown in Table I. PVP and ΔP over 7 mmHg were obtained in only 2 dogs. When chest was opened, PVP increased in 5 dogs, decreased in 2 dogs, but CVP increased and ΔP decreased in all dogs.

In post-operative patients, PVP was averaged 21.1 ± 5.6 (ranged 6.4 to 34.5) cmH₂O, ΔP was 5.3 ± 3.6 (0.7 to 17.7) cmH₂O. Chronological changes of PVP and ΔP were remarkable in those cases who developed some circulatory failure in early post-operative period. An example in which post-operative hemorrhage was complicated and re-operation was performed for cardiac tamponade was shown in Fig. 1. These changes were relatively small in the uncomplicated cases.

DISCUSSION AND CONCLUSION

Guyton³ reported that Pms in dogs were 7 mmHg, but PVP and ΔP were under 7 mmHg in 5 out of 7 dogs in this experiment. Therefore, PVP seems to be normally lower than Pms in

dogs. It is interesting that our clinical data revealed much higher PVP than in dogs. The data obtained in this study are also higher than those reported by Eustace⁴ and Pedersen⁵. This is probably because 22 cases of our patients are of Tetralogy of Fallot. As shown in Fig. 1, the changes of PVP are not necessarily parallel to that of CVP suggesting that PVP could be an independent parameter of CVP. Although the information obtained from PVP and ΔP was not clear at present moment, combination of changes in each venous pressure seems to give us a helpful information to understand the state of general circulation, especially in critical cases. Table II schematically represents the changes of PVP, CVP, and ΔP in different circulatory disturbances which were analyzed graphically and theoretically based on Guyton's theory.

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