

TITLE: SWAN GANZ CATHETER PLACEMENT: RELATIONSHIP TO INTRA-BALLOON PRESSURES

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INTRODUCTION

A serious and potentially lethal complication of the pulmonary artery catheter is rupture of the pulmonary artery. The exact cause of this rare complication is unclear, however it possibly is due to a combination of improper catheter position and balloon inflation techniques. This investigation studied the pressure-volume characteristics of balloon inflation and utilized the results to suggest a guide to catheter positioning.

METHODS

After Human Investigation Committee approval, static pressure-volume relationships of 5 Edwards® pulmonary artery catheter balloons were determined by measuring the pressure exerted at the balloon injection port after each of 6 sequential 0.25cc increments of air were injected. These measurements were performed before and immediately after catheter insertion and were compared with a two way analysis of variance with $p < 0.05$ being significant. After insertion, pulmonary artery mean and pulmonary artery occlusion (PA_o) pressures were measured simultaneously with intra-balloon pressures. In addition to these static pressure measurements, continuous pressure recordings were obtained during balloon inflation.

RESULTS

Figure 1 shows that pressure and injected volume have a linear relationship to the point of instantaneous balloon expansion, i.e., the balloon expands only after obtaining a critical pressure. Pre-insertion expansion occurred at a pressure of 421 ± 89 mmHg followed by a rapid pressure decrease that remained constant despite additional volume. Post-insertion inflation indicated by the drop in pressure occurred at 390 ± 71 mmHg. Pre- and post-insertion pressure volume relationships had similar trends, $p > 0.05$. Figures 2 and 3 present continuous balloon and pulmonary artery pressure tracings obtained during balloon inflation in one patient. Figure 2 shows that PA_o occurred simultaneously with balloon inflation. After withdrawing the catheter 2 cm, (fig. 3) PA_o did not occur with initial inflation, but required the injection of additional volume.

DISCUSSION

Before insertion of the catheter, instantaneous balloon expansion was accompanied by a rapid decrease in pressure that was easily detected as a loss of resistance in the inflating syringe. Following insertion, the reductions in balloon pressure and syringe resistance again were detected and probably corresponded to balloon inflation. If instantaneous balloon expansion from zero volume occurs in a PA of smaller diameter than the expanded balloon, then distortion and transfer of extreme pressure could result in rupture of the PA. To minimize the risk of this complication, we maintain that a PA_o tracing should not occur simultaneously with loss of resistance in the inflating syringe (balloon inflation) (Fig. 2). The catheter should be

positioned such that additional volume following initial balloon expansion is required to obtain a wedge trace, (fig. 3). This technique ensures that the balloon inflates only to occlusion and does not overdilate the pulmonary artery during expansion, therefore reducing the risk of pulmonary artery rupture.

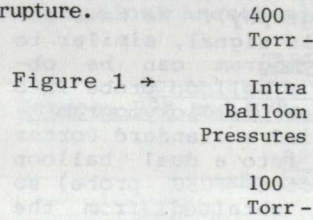


Figure 1 →

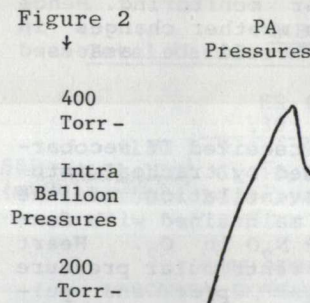
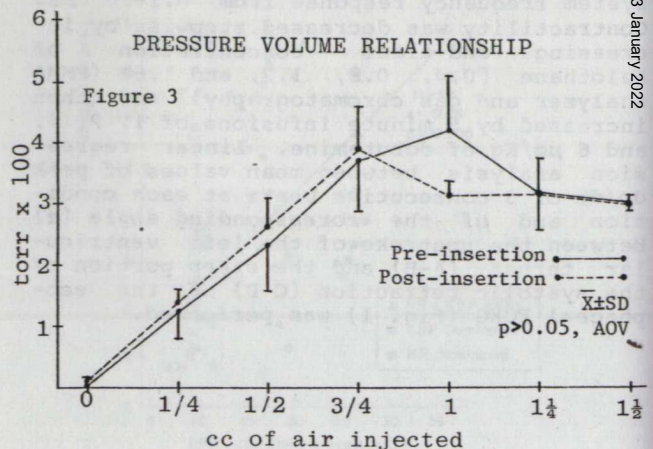
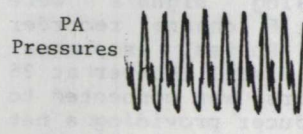


Figure 2
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