

Title: OXYGEN REQUIREMENT IN POSTBYPASS PERIOD

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Introduction: The relationship between whole body oxygen uptake ($\dot{V}O_2$) and oxygen delivery is important in understanding tissue oxygen requirement and perfusion need. Also, the information will aid the interpretation of mixed venous oxygen tension ($P\bar{V}O_2$) or saturation ($S\bar{V}O_2$). Previously, we¹ reported that $\dot{V}O_2$ plateaued at about 108 ml/min/M² when oxygen delivery was greater than 330 ml/min/M² in anesthetized patients during prebypass period. The purpose of this report was to examine the relationship between $\dot{V}O_2$ and oxygen delivery in the postbypass period where oxygen requirement may be different from the prebypass period.

Material and Methods: Eighty-nine patients who underwent elective coronary artery bypass graft (CABG) surgery were studied with approval by the Research Committee. Anesthesia consisted of diazepam, moderate dose of fentanyl, pancuronium and 50% N₂O/O₂. Multiple hemodynamic parameters were obtained and $\dot{V}O_2$ and oxygen delivery were calculated. There were 131 sets of measurements during the early (15-30 minutes) postbypass period and 136 sets of measurements during the late (1-2 hours) postbypass period.

Results: The relation between $\dot{V}O_2$ and oxygen delivery is shown in Fig. 1. During the early postbypass period, $\dot{V}O_2$ increased in proportion to oxygen delivery ($y=33.00 + 0.25x$; $r=0.80$, $P<10^{-9}$, $n=131$). During the late postbypass period, $\dot{V}O_2$ also appeared proportional to oxygen delivery, but the slope and correlation coefficient were less ($y=50.21 + 0.17x$, $r=0.64$, $P<10^{-8}$) and the difference between the two slopes of these regression lines were statistically significant ($P<0.005$). When oxygen delivery levels were less than 330 ml/min/M², the regression line in the early postbypass period was expressed as: $y=33.90 + 0.24x$, $r=0.57$, $P<10^{-8}$, $n=101$ and at the late postbypass period: $y=33.72 + 0.24x$, $r=0.57$, $P<10^{-8}$, $n=101$. Thus, these two regression lines were identical with that of the early postbypass period covering the entire range of oxygen delivery. When oxygen delivery levels were greater than 330 ml/min/M² at the late postbypass period, $\dot{V}O_2$ values tend to plateau at the level of 115 ± 15 ml/min/M² ($r=0.12$, $n=34$). The relationship between $P\bar{V}O_2$ and oxygen delivery was such that at the early postbypass period correlation was poor ($r=0.31$) with $P\bar{V}O_2$ scattering from 26 to 48 torr and at the late postbypass period the correlation improved ($r=0.57$) with mean $P\bar{V}O_2$ 35.7 ± 4.7 torr. Mean values of temperature, hemoglobin, mixed venous pH and P_{50} (in vivo) during the early and late postbypass period were: 36 ± 0.8 and 35.2 ± 0.7 (°C); 8.2 ± 1.1 and 9.3 ± 1.3 (gm/dl); 7.36 ± 0.03 and 7.35 ± 0.04 ; 28.25 ± 2.7 and 28.7 ± 2.4 (torr) respectively.

Discussion: During the early postbypass period,

$\dot{V}O_2$ did not plateau, instead increased in proportion to oxygen delivery. This finding suggests that the patient was in the state of oxygen conformity and oxygen debt that occurred during the extracorporeal circulation was being returned. During this period, $P\bar{V}O_2$ did not correlate with oxygen delivery or cardiac output presumably because the oxygen extraction rate was not lowered when oxygen delivery increased. At the late postbypass period, oxygen requirement appeared approaching plateau, therefore $P\bar{V}O_2$ resumed its correlation with oxygen delivery. When the oxygen delivery levels were less than 330 ml/min/M², the regression lines were identical at both early and late postbypass period. This observation suggests that the critical level of oxygen delivery identified as 330 ml/min/M² in prebypass period¹ may also apply in the postbypass period.

Reference: (1) Komatsu T, Shibutani K, Bizzarri D: Critical level of oxygen delivery in anesthetized man. *Anes Analg* 61:196, 1982.

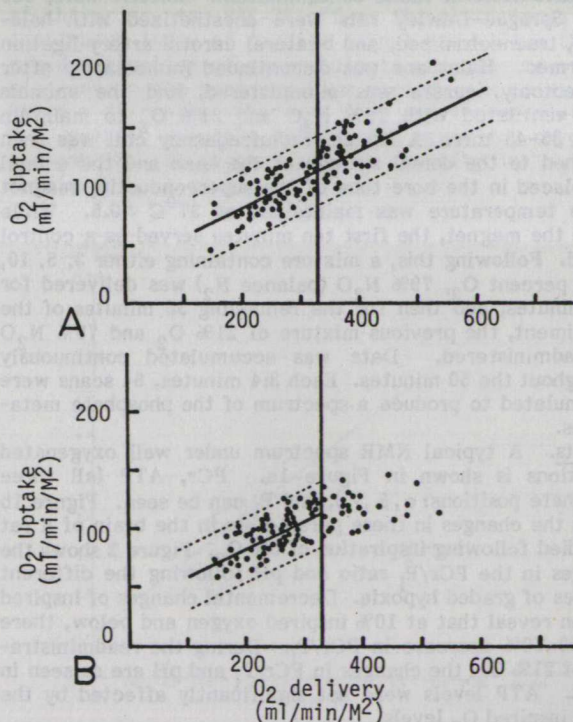


Fig. 1. Relationship between O₂ uptake and delivery in the early (A) and late (B) postbypass period.