

Title: PATTERNS OF SERIAL BLOOD LACTATE LEVELS AND HEMODYNAMICS IN PATIENTS UNDERGOING CORONARY ARTERY BYPASS SURGERY

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INTRODUCTION: Hemodynamics and oxygen transport variables are established indicators necessary to assess cardiac performance and adequacy of tissue oxygenation during the perioperative period. Recently, sequential determination of blood lactate has been suggested as a useful indicator in assessing oxygen deficit and in titrating therapy to support the necessary physiological compensations.¹ However, the relationship between lactate levels and parameters, related to hemodynamics and oxygen transport has not been clearly known. Therefore, we have examined whether the elevation of lactate levels can be explained by the pattern of oxygen delivery (DO_2) and oxygen uptake (VO_2) in anesthetized patients undergoing coronary artery bypass graft (CABG) surgery.

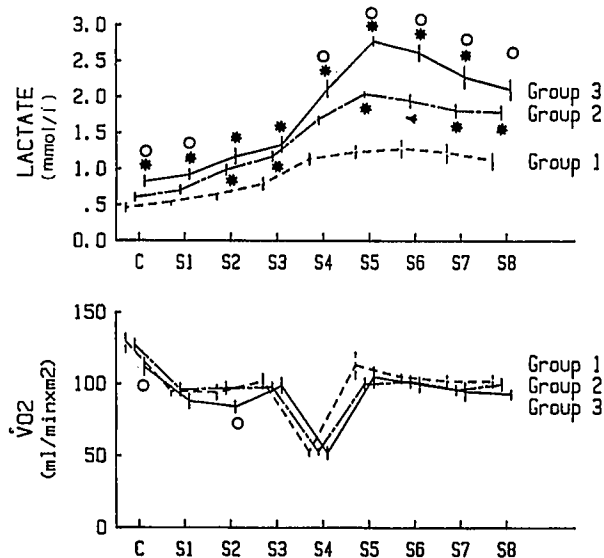
METHODS: Sixty-three patients who were scheduled for elective CABG surgery were studied. As a premedication, morphine sulfate 0.1mg/kg was administered 60 minutes prior to induction of anesthesia. Anesthesia was induced with fentanyl, diazepam and pancuronium and ventilated with oxygen-air mixture (total doses of fentanyl $101 \pm 27 \mu\text{g}/\text{Kg}$, diazepam $0.57 \pm 0.14 \text{mg}/\text{Kg}$). All patients were monitored with ECG. Under local anesthesia, radial arterial cannulation and pulmonary artery catheterization were performed. Hemodynamic and arterial blood lactate (LACT) measurements were performed serially at preinduction (C), postinduction (S1), sternotomy (S2), cannulation (S3), during bypass (S4), 15 minutes postbypass (S5), protamine infusion (S6), end of operation (S7), and 15 minutes after arrival at the recovery room (S8). During bypass, mean arterial pressure (MAP) was maintained at 70 torr, flow at $1.8 \pm 0.1/\text{m}^2$ and blood temperature at 25°C . The patients were divided into 3 Groups retrospectively according to the levels of lactate at P1. In Group 1 ($n=17$), lactate were less than 1.6 mmol/L. In Group 2 ($n=29$), lactate were between 1.7 to 2.4 mmol/L. In Group 3 ($n=17$), lactate were greater than 2.5 mmol/L.

RESULTS: The results are shown in the figure. The Lactate levels increased following cardiopulmonary bypass in all groups and reached at the highest levels at S5 and then gradually decreased. Lactate levels of Group 3 were consistently higher than Group 1 and Group 2 throughout the course of surgery, yet there were no significant differences among the groups in hemodynamic and oxygen transport variables. The only exceptions were a decrease of cardiac index (CI) and DO_2 at S1 in Group 2. There were no significant differences among the groups in mixed venous oxygen saturation (SvO_2) and VO_2 except a decrease of VO_2 at S2 in Group 3. **DISCUSSION:** Though Waxman¹ reported the inverse relationship between intraoperative VO_2 and lactate levels, we did not find such relationship. Though it is well known that reductions of

VO_2 and elevations of lactate occurs in severe hypoperfusion, our findings suggest that lactate levels may be also influenced by factors other than DO_2 , VO_2 , and SvO_2 in anesthetized patients. A further study of lactate production and clearance may be needed to determine whether sequentially determined lactate can be a useful indicator or not in assessing oxygen deficit or perfusion failure.

REFERENCES

1. Waxman K, Nolan LS, Shoemaker WC: Sequential perioperative lactate determination. Physiological and clinical implications. Crit Care Med 10:96-99, 1982



* $p < 0.05$ as compared to G1
o $p < 0.05$ as compared to G2

Fig. 1 Sequential changes of blood lactate and oxygen uptake.