

To Study the Effect of Oxygen Supplementation in Tourniquet Used Limb Surgeries By Using Blood Gas Analysis

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Abstract

Background: To study the effects of oxygen supplementation on the metabolic and anaerobic changes caused by tourniquet application in limb surgeries using blood gas analysis. **Methodology:** This study was conducted with 60 adult patients in the 18–65 age group of ASA physical status I and II undergoing limb surgeries using tourniquet are randomly assigned to one of two groups 1 and 2 containing 30 patients each. Group 1: 30 patients received nasal oxygen 3 l/min after tourniquet application. Group 2: 30 patients received preoxygenation for 5 min before tourniquet in addition to 3 l/min nasal oxygen during tourniquet. Arterial blood samples are collected before and 3 min after tourniquet respectively and analyzed for blood gases and lactate levels. **Results:** Patients who received preoxygenation showed reduced metabolites and reduced serum lactate when compared to the group which was not preoxygenated. This difference in serum lactate was found to be statistically significant (p -value < 0.0001). Similarly the pH of the group which was preoxygenated within the normal limit while the group not preoxygenated shown acidotic pH, the difference in pH was also found to be statistically significant (p -value < 0.0001). **Conclusion:** The effect of oxygen supplementation in reducing the anaerobic metabolism was studied in patients Undergoing limb surgeries using tourniquet. It was found that the patients who received preoxygenation showed reduced serum Lactate levels and normal pH when compared to those who were not preoxygenated. Hence it is concluded that preoxygenation reduces anaerobic metabolism in surgeries done under tourniquet.

Keywords: Tourniquet; Blood gas analysis; Lactate Levels; Oxygenation.

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Introduction

Tourniquets are often used to produce a bloodless surgical field, reduces bleeding during surgery, provide better surgical conditions and shorten the duration of operation-related complications.

There is a need for information about the systemic and local effects of tourniquet use in persons of

good physical status.¹ For a proper functional state, the peripheral tissues depend on an adequate supply of oxygen and an adequate microcirculation. Tourniquet application associated with biochemical and haemodynamic changes causes increase in systemic blood pressure, central venous pressure and heart rate. After the release of tourniquet reactive anaerobic metabolites entering into the

circulation cause vasodilatation in the capillaries of the muscles.² When we apply tourniquet the temperature of that particular limb falls due to absent blood supply and when it is released this cold blood enters into the general circulation. The core temperature as a result can reduce to 0.7 degree. Applying tourniquet for more than 30 min causes increase in acidosis, hypercapnia, increased serum potassium and toxic metabolites.

Aims and Objectives

To study the effects of oxygen supplementation on the metabolic and anaerobic changes caused by tourniquet application in limb surgeries using blood gas analysis.

Materials and Methods

This prospective randomized case control study was conducted on 60 adult patients of ASA physical status I and II in the 18-65 age group undergoing limb surgeries using tourniquet after taking informed consent at KIMS Medical College and RF, Amalapuram.

Inclusion criteria

- A. Patients undergoing limb surgeries using tourniquet
- B. Both sexes
- C. Age: 18-65 years
- D. Patients belonging to ASA I or II
- E. Hb more than 10.0 gm

Exclusion criteria

- A. Patient refusal
- B. Patients with

- neuromuscular disorders.
- respiratory compromise.
- cardiovascular disease.
- renal disorder

Methodology

Patients scheduled for limb surgeries using tourniquet are eligible for the study. 60 patients are randomized into two groups. In a randomized manner 30 patients received nasal oxygen 3 l/min after tourniquet application (Group 1), and 30 patients receive preoxygenation for 5 min before tourniquet in addition to 3 l/min nasal oxygen during tourniquet (Group 2). Arterial blood samples and venous blood samples are collected before and 3 min after tourniquet respectively and analyzed for blood gases and lactate levels.¹

Parameters to be Monitored³

pH, HCO₃, Lactate, pCO₂, paO₂.
PR, BP, SpO₂, pCO₂.

Observations and Results

As per Table 1, mean age of patients in study group 1 was 33.8 years and control group 2 was 34.7 years with *p*-value of 0.24 and they are comparable to each other statistically. Similarly both the groups were comparable statistically to each other with respect to duration of the procedure and sex distribution.

Regarding the blood gas analysis values, lactate levels in group 1 was 0.84 ± 0.032 and group 2 was 1.59 ± 0.096 with *p*-value of 0.00014 indicating higher lactate levels in control group, so they are

Table 1: Demographic Profile and Preoperative Parameters in both Study and Control Group

Parameters	Study Group	Control Group	<i>p</i> -value
Age (years)	33.8 ± 1.42	34.7 ± 3.60	0.243
sex (m/f)	26/4	27/3	0.465
Duration of the procedure (min)	48.652 ± 6.53	50.49 ± 7.82	0.312
Lactate levels	0.84 ± 0.038	1.59 ± 0.096	0.00014
Preoperative pH value	7.24 ± 0.23	7.30 ± 0.02	0.412
Preoperative pO ₂ (mm Hg)	90.14 ± 6.72	91.99 ± 8.32	0.996
Preoperative pCO ₂ (mm Hg)	39.90 ± 2.32	41.44 ± 4.29	0.452
Preoperative bicarbonate	24.01 ± 1.23	22.43 ± 1.20	0.32
Preoperative SpO ₂	95.48 ± 1.2	96.03 ± 1.33	0.410

statistically different. Preoperative values of blood gas analysis like pO_2 , pCO_2 , bicarbonate and SpO_2 were comparable and so there is no statistically significant difference.

Coming to analysis of the postoperative blood gas analysis values, pH value of the group 1 was 7.38 ± 0.02 and group 2 was 7.24 ± 0.01 with p -value of 0.0001, both comparable statistically. pO_2 values of group 1 and group 2 were 38.90 ± 1.54 and 35.61

± 1.66 with p -value of 0.0001, PCO_2 values of group 1 and group 2 were 51.52 ± 2.61 and 53.90 ± 1.79 with p -value of 0.0002. Bicarbonate values were 23.97 ± 1.62 and 24.47 ± 1.10 for group 1 and 2 with p -value of 0.0001. Postoperative blood gas analysis values are comparable statistically. However postoperative SpO_2 values are not comparable with their p -value of 0.4710 (Table 2).

Table 2: Postoperative Values

Parameters	Study Group	Control Group	p -value
Postoperative pH	7.38 ± 0.02	7.24 ± 0.01	<0.0001
Postoperative pO_2	38.90 ± 1.54	35.6 ± 1.66	0.0001
Postoperative pCO_2	51.52 ± 2.61	53.9 ± 1.79	0.0002
Postoperative bicarbonate	23.97 ± 1.62	24.47 ± 1.1	0.0001
Postoperative SpO_2	97.03 ± 1.72	98.79 ± 1.3	0.4710

Discussion

Tourniquet application is one of the preferred methods for obtaining a bloodless operative field.^{4,5} At the same time it has its own disadvantages. It has the tendency to increase the anaerobic metabolism due to oxygen deprivation in the tissue under tourniquet.⁶ This study was done as a trial to reduce the anaerobic metabolism.

Newman in his study has found that when the duration of tourniquet exceeds 30 min, anaerobic metabolism sets in. Similar to his study, our study also shows anaerobic metabolism as evidenced by increase in serum lactate levels since the average duration of tourniquet in our study was about 45 min.

In this study, the age and sex characteristics of both the groups were compared and found to be not statistically significant. The mean preoperative pH values of both the groups were 7.38 ± 0.02 and were not significant.

The mean postoperative pH of our study group was 7.38 ± 0.02 and control group was 7.24 ± 0.001 . They were found to be statistically significant. The serum lactate levels were also found to be significant statistically.

By supplementing oxygen, we can improve the oxygen content of the blood thereby increasing the reserve of the oxygen, this can help during oxygen deficiency during tourniquet.⁷⁻⁹

The supplemental oxygen as given in the form of preoxygenation increases the fraction of the

oxygen dissolved in the blood thereby increasing the oxygen reserve.¹⁰

Summary and Conclusion

In this study we evaluated the effect of oxygen supplementation in tourniquet used limb surgeries.

In this study, the age and sex characteristics of both the groups were compared and found to be not statistically significant.

Similarly, the preoperative pH, pO_2 , pCO_2 of both the groups were found to be not statistically significant.

The preoperative values of HCO_3 , SpO_2 were compared in both the groups and found to be statistically not significant.

The mean duration of tourniquet application in both the groups were similar and found to be statistically not significant.

So both the groups were similar in the study parameters before tourniquet application.

When both the groups were compared with respect to their post-tourniquet values, it was found that the group which received preoxygenation showed reduced anaerobic metabolites and reduced serum lactate when compared to the group which was not preoxygenated. This difference in serum lactate was found to be statistically significant. Similarly the pH of the group which was preoxygenated within the normal limit while the group not preoxygenated shown acidotic pH, the difference in pH was also found to be statistically significant.

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