IOSR Journal of Dental and Medical Sciences (IOSR-JDMS)
e-ISSN: 2279-0853, p-ISSN: 2279-0861.Volume 21, Issue 1 Ser.8 (January. 2022), PP 45-58
www.iosrjournals.org

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

Dr.SIVABALAN R G, *Assistant Prof ,Anaesthesia ,Madras medical college*.,
Dr.P S RAJESWARI, *Assistant Prof ,Anaesthesia ,Madras medical college*.

I. Introduction:

Using a tourniquet to produce a blood free surgical field is accepted by everyone in surgery. There is a need for information about the systemic and local effects of tourniquet use in persons of good physical status. For a proper functional state, the peripheral tissues depend on an adequate supply of oxygen and an adequate microcirculation. Tourniquet application causes increase in systemic blood pressure, central venous pressure and heart rate. When we release the tourniquet reactive anaerobic metabolites are released into the circulation which cause vasodilatation in the capillaries of the muscles. 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 0.6 degrees. Applying tourniquet for more than 30mins causes increase in acidosis, hypercapnia, increased serum potassium and toxic metabolites.

Aim of this study is to highlight the effect of oxygen supplementation in tourniquet used limb surgeries.

AIM OF THE STUDY:
To study the effects of oxygen supplementation on the metabolic and anaerobic changes caused by tourniquet.

II. Materials And Methods

STUDY TYPE	:	INTERVENTIONAL.
DESIGN OF STUDY	:	PROSPECTIVE RANDOMISED CASE CONTROL STUDY
PLACE OF STUDY	:	MADURAI MEDICAL COLLEGE
STUDY POPULATION	:	CASES POSTED FOR LIMB SURGERIES
DATA COLLECTION	:	DATA REGARDING HISTORY, CLINICAL EXAMINATION,

RADIOLOGICAL EXAMINATION.

INCLUSION CRITERIA:

Elective limb surgeries.

Both sexes

Age: 18-65 years

ASA I & II

HB more than 10.0gms.

EXCLUSION CRITERIA:

Patient's refusal.

Patients with documented neuromuscular disorders.

Patients with respiratory compromise.

Patients of cardiovascular disease.

Patients with renal disorder.

III. 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 5mins 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 3mins after tourniquet respectively and analysed for blood gases and lactate levels.

Statistical Tools.

The information collected regarding all the selected cases were recorded in a Master Chart. Data analysis was done with the help of computer using

Epidemiological Information Package (EPI 2010) developed by Centre for Disease Control, Atlanta.

Using this software range, frequencies, percentages, means, standard deviations, chi square, 't' value and 'p' values were calculated. 't' test was used to test the significance of difference between quantitative variables and Yate's and Fisher's chi square tests for qualitative variables. A 'p' value less than 0.05 is taken to denote significant relationship

PARAMETERS TO BE MONITORED:

PH,Hco3,Lactate,Pco2,Pao2.

PR, BP, SPO2,PCO2.

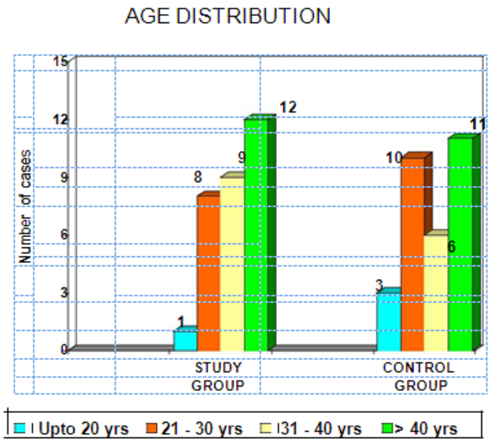
IV. Observations And Results.

A:PROFILE OF CASES STUDIED

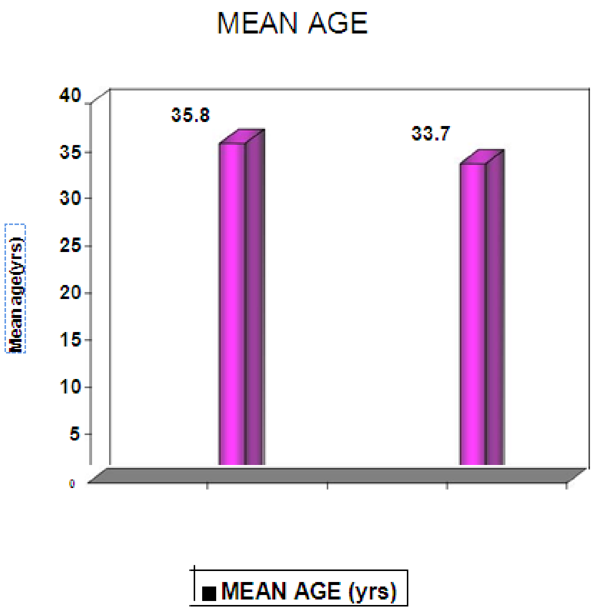
Table A1: Age Distribution

Age Group	No of Cases in			
	Study Cases		Controls	
	No	%	No	%
Up to 20 yrs	1	3.3	3	10
21 – 30 yrs	8	26.7	10	33.3
31 – 40 yrs	9	30	6	20
Above 40 yrs	12	40	11	36.7
Total	30	100	30	100
Range	19 – 46 yrs		18 – 45 yrs	
Mean	35.8 yrs		33.7 yrs	
SD	8.1 yrs		9.4 yrs	
'p'	0.3497 Not significant			

As indicated in the above table the age characteristics of both the case and control group are compared and there are similar and no statistical difference exists between the two.



As indicated in the above the age characteristics of both the case and control group are compared and there are similar and no statistical difference exists between the two.



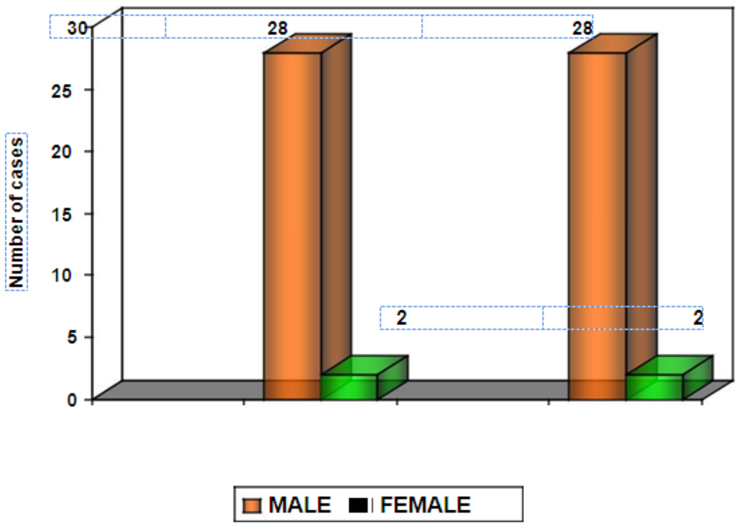
As indicated above the mean age of both the group are not statically significant.

Table A2: Sex Distribution

Sex	No of Cases in			
	Study Group		Control Group	
	No	%	No	%
Male	28	93.3	28	93.3
Female	2	6.7	2	6.7
'p'	1.0 Not significant			

There is no statistical difference between the sex distribution of both the groups.

SEX DISTRIBUTION



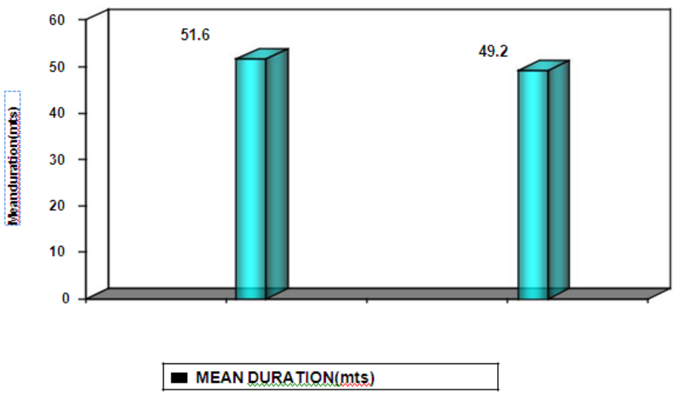
There is no statistical difference between the sex distribution of both the groups.

Table A3: Duration

Group	Duration of procedure (in minutes)	
	Mean	**SD**
Study	51.6	7.5
Controls	49.2	7.7
'p'	0.2199 Not significant	

As indicated above there is no statistical difference between the duration in both the groups.

DURATION



As indicated above there is no statistical difference between the duration in both the groups.

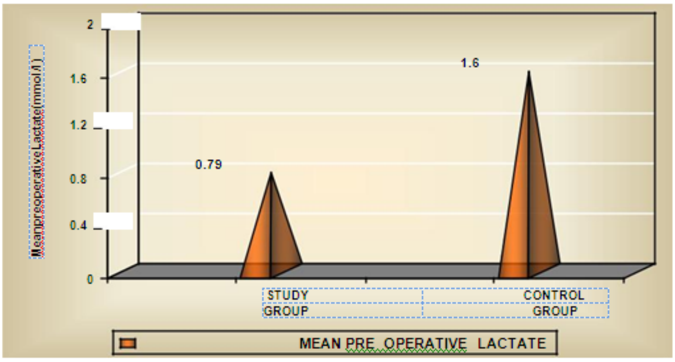
TABLE B: OPERATIVE VALUES

Table B1: Lactate (mmol/l)

Group	Lactate (mmol/l)	
	Mean	SD
Study	0.79	0.18
Controls	1.6	0.48
'p'	**<0.0.0001 Significant**	

As evidenced by the above table there is statistical difference between the lactate levels in both the groups indicating a higher lactate level in control group.

LACTATE



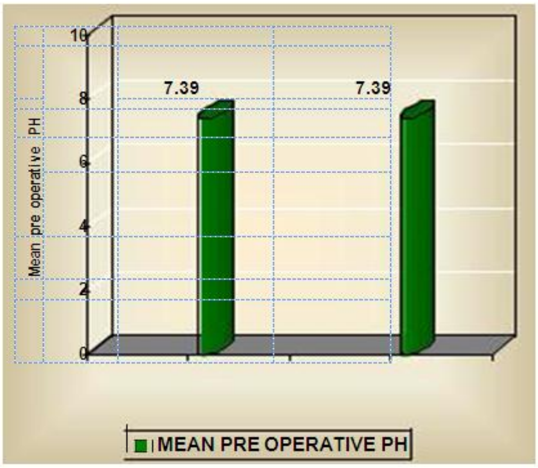
As evidenced by the lactate levels in both the group. above table there is statistical difference between the groups indicating a higher lactate level in control

Table B2: Preoperative PH Value

Group	Pre operative PH	
	Mean	SD
Study	7.39	0.02
Controls	7.39	0.02
'p'	0.351 Not significant	

As seen above there is no statistical significant difference between the Pre operative PH values of both groups.

PRE OPERATIVE PH



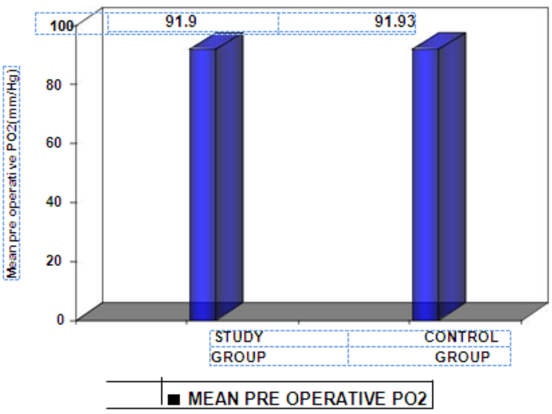
As seen above there is no statistical significant difference between the Pre operative PH values of both groups.

Table B3: **Preoperative PO_2 (mm/Hg)**

Group	Pre operative PO2 (mm/Hg)	
	Mean	**SD**
Study	91.9	1.88
Controls	91.93	2.08
'p'	0.9484 Not significant	

There is no statistical difference between the preoperative PO2 values in both the groups.

PRE OPERATIVE PO2



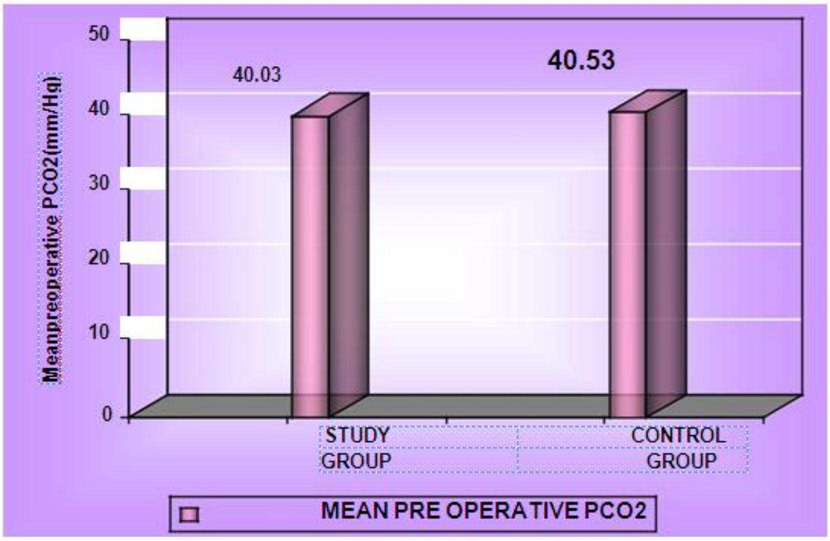
There is no statistical difference between the preoperative PO2 values in both the groups.

Table B4:Pre operative PCO2 (mm/Hg)

Group	Pre operative PCO2 (mm/Hg)	
	Mean	**SD**
Study	40.03	1.97
Controls	40.53	2.18
'p'	0.3552 Not significant	

There is no statistical significant difference between the preoperative PCO2 values in both the groups.

PRE OPERATIVE PCO2



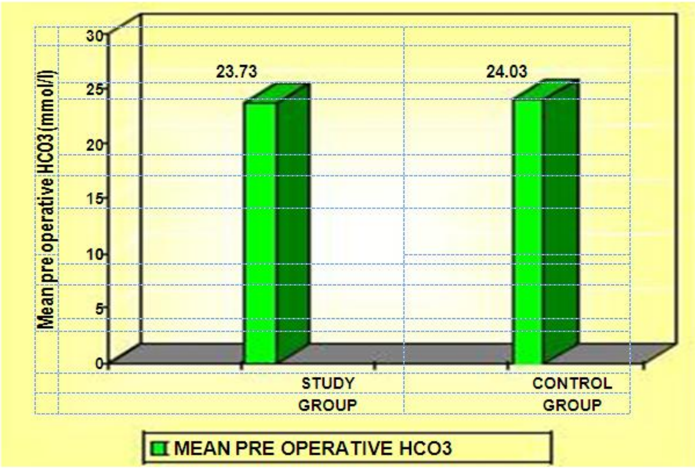
There is no statistical significant difference between the preoperative PCO2 values in both the groups.

Table B5: **Pre operative HCO3**

Group	Pre operative HCO3 (mmol/l)	
	Mean	**SD**
Study	23.73	1.23
Controls	24.03	1.4
'p'	0.3818 Not significant	

There is no statistical difference between the preoperative bicarbonate levels in both the groups.

PRE OPERATIVE HCO3



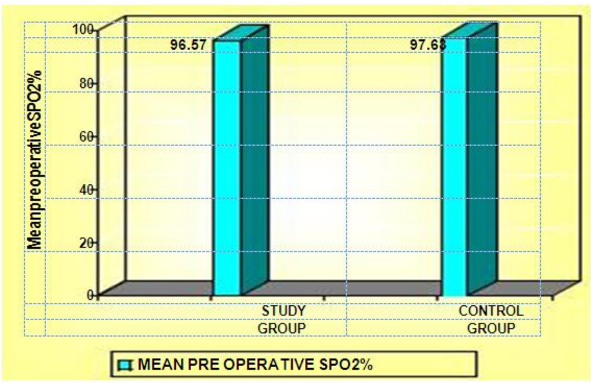
There is no statistical difference between the preoperative bicarbonate levels in both the groups.

Table B6: Pre operative SPO2 (%)

Group	Pre operative SPO2 (%)	
	Mean	**SD**
Study	96.57	1.72
Controls	97.63	1.4
'p'	**0.3107 Not Significant**	

There is no statistical significant difference between the preoperative SPO2 values in both the groups.

PRE OPERATIVE SPO2%



There is no statistical significant difference between the preoperative SPO2 values in both the groups.

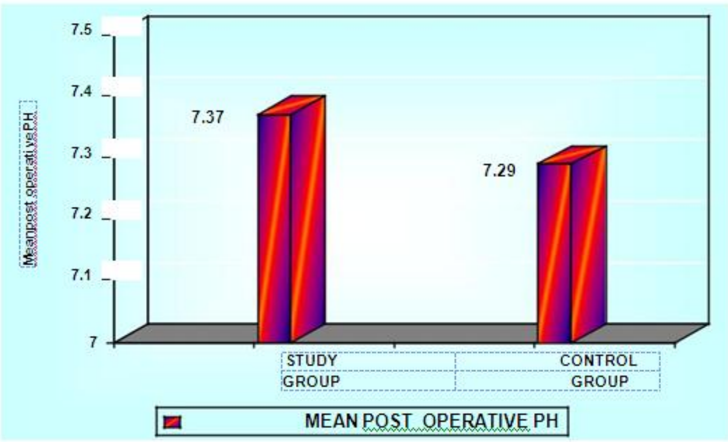
C: POST OPERATIVE VALUES

Table C1: Postoperative PH

Group	Post operative PH	
	Mean	SD
Study	7.37	0.03
Controls	7.29	0.01
'p'	<0.0001 Significant	

There is a statistical significant difference between both the groups in terms of PH with control group showing more acidosis.

POST OPERATIVE PH



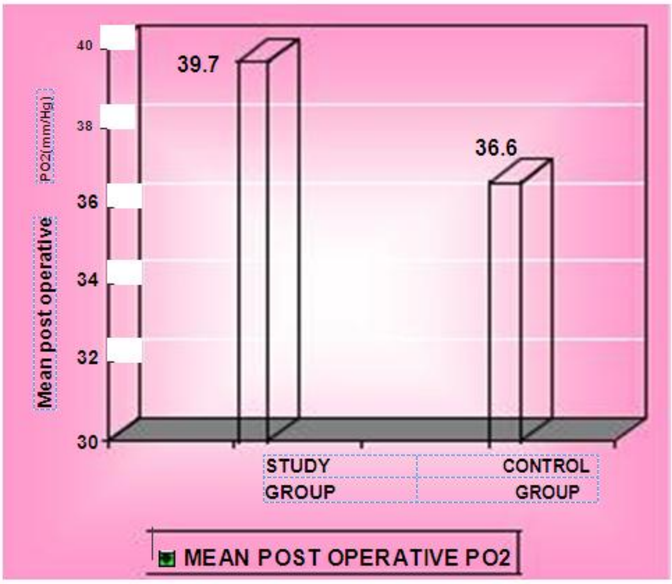
There is a statistical significant difference between both the groups in terms of PH with control group showing more acidosis.

Table C2: Postoperative PO2 (mm/hg)

Group	Post operative PO2 (mm/hg)	
	Mean	SD
Study	39.7	1.53
Controls	36.6	1.77
'p'	<0.0001 Significant	

There is a statistical significant difference between both the groups in post operative PO2 values.

POST OPERATIVE PO2



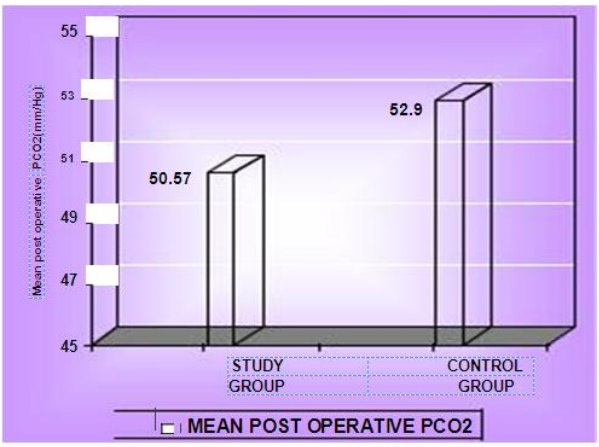
There is a statistical significant difference between both the groups in post operative PO2 values.

Table C3: Post operative PCO2 (mm/Hg)

Group	Post operative PCO2 (mm/Hg) Mean	SD
Study	50.57	2.61
Controls	52.9	1.79
'p'	0.0002 Significant	

There is a statistical significant difference between the post operative PCO2 values in both the groups.

POST OPERATIVE PCO2



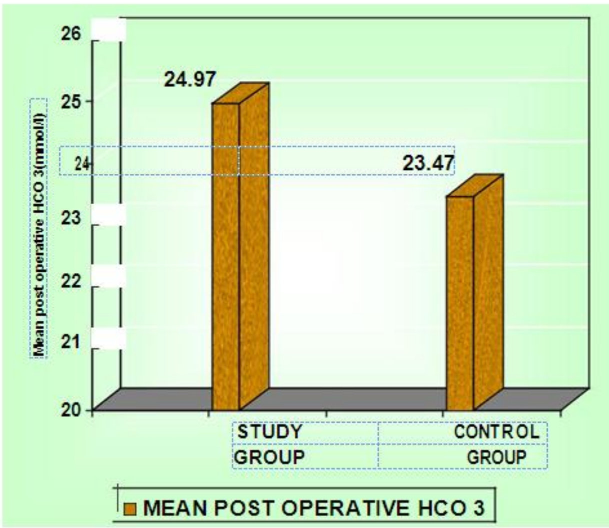
There is a statistical significant difference between the post operative PCO2 values in both the groups.

Table C4: Postoperative HCO3

Group	Post operative HCO3 (mmol/l)	
	Mean	SD
Study	24.97	1.63
Controls	23.47	1.2
'p'	0.0001 Significant	

There is a statistical significant difference between the post operative HCO3 values in both the groups.

POST OPERATIVE HCO 3



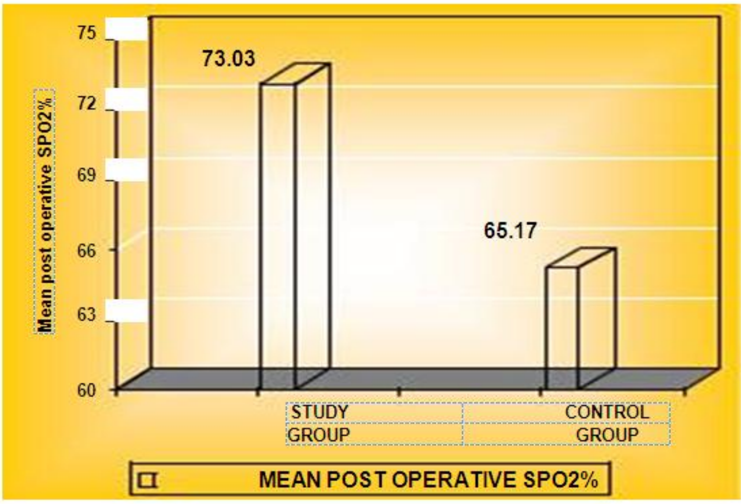
There is a statistical significant difference between the post operative HCO3 values in both the groups.

Table C5: Postoperative SPO2

Group	Postoperative SPO2 (%)	
	Mean	SD
Study	73.03	4.31
Controls	65.17	2.56
'p'	<0.0001 Significant	

There is a statistical significant difference between the post operative SPO2values in both the groups.

POST OPERATIVE SPO2 %



There is a statistical significant difference between the post operative SPO2values in both the groups.

V. Discussion

Tourniquet application1 is one of the preferred methods for obtaining a bloodless surgical field. At the same time it has its own disadvantages. It has the tendency to increase the anaerobic metabolism due to oxygen deprivation in the tissues under touniquet2. This study was done in a trial to reduce the anaerobic metabolism.

Newman in his study has found that when the duration of tourniquet exceeds 30mins, anaerobic metabolism5 set in. Similar to his study, our study also shows anaerobic metabolism as evidenced by increase in lactate levels6 since the average duration of tourniquet in our study is about 45mins.

After the release of tourniquet,reperfusion injury3 occurs due to accumulated lactates.This reperfusion injury4 causes acidosis which is detrimental to patients who are already in sepsis.

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

The mean pre operative PH of both the case and control group was 7.39±0.02 and that was not statistically significant.

The mean post operative PH of study group was 7.37±0.03 and that of the control group was 7.29±0.01.These values were found to be statistically significant.

The mean Serum lactate levels in the study group was 0.79 with a standard deviation of 0.18 while that of the control group was 1.6±0.48.These were also found to be statistically significant.

By supplementing oxygen, we can improve the oxygen content of blood thereby increasing the reserve oxygen. This increased reserve oxygen can help in the period of oxygen deficiency during tourniquet. The supplemental oxygen as given in the form of preoxygenation increases the fraction of dissolved oxygen in the blood there by increasing the oxygen reserve. This reserve is the key for the favorable outcome.

However this study has its own limitations. The tourniquet pressure was not standardised as some surgeries are done using pneumatic tourniquet while the others using compression esmark tourniquet. Moreover, CPK, serum Lactic acid levels, and quantitative H+ concentrations could not be done due to the lack of facilities. Even if they were done they have the impact of the primary pathology rather than the tourniquet alone.

However this study could be done in more sample of patients with more relevant and added study parameters in future to increase its practical significance.

VI. Summary

In this study we evaluated the effect of oxygen supplementation in tourniquet used limb surgeries. Sixty patients of ASA 1and 2 were divided into two groups of 30 each.

GROUP 1: Receive nasal oxygen 3 l/min throughout the surgery.

GROUP 2: Preoxygenated for 5mins before tourniquet application and receive oxygen 3 l/min throughout the procedure.

The study was conducted in Govt.Rajaji Hospital and Madurai Medical College Madurai, from September 2013 to August 2014.

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, PO2, PCO2 of both the groups were found

to be not statistically significant.

The preoperative values of HCO3, SPO2 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
110 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 was found within the normal limit while the group not preoxygenated exibited an acidotic PH.This difference in PH was also found to be statistically significant.

VII. 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.

Bibliography

[1]. Junge B, Hoffmeister H, Feddersen HM, Rocker L. Standardisation of obtaining blood samples: influence of tourniquet application on 33 constituents of blood and serum. Dtsch Med Wochenschr 1978;103:260–5.
[2]. Thompson JM. Blood collection and preparation: preanalytical variation. In: Jesperson J, Bertina RM, HaverkateF, editors. ECAT assay procedure. A manual of laboratory techniques. Dordrecht: Kluwer Academic Publishers, 1992:13–20.
[3]. McNair P, Nielsen SL, Christiansen C, Axelsson C. Gross errors made by routine blood sampling from two sites using a tourniquet applied at different positions. Clin Chim Acta 1979;98:113–8.
[4]. ECSH Expert Panel on Blood Rheology, Guidelines for Measurement of Blood-Viscosity and Erythrocyte Deformability. Clin Hemorheol 1986;6:439–53.
[5]. Connes P, Uyuklu M, Tripette J, Boucher JH, Beltan E, Chalabi T, et al. Sampling time after tourniquet removal affects erythrocyte deformability and aggregation measurements. Clin Hemorheol Microcirc 2009;41:9–15.
[6]. Bor-Kucukatay M, Wenby RB, Meiselman HJ, Baskurt OK. Effects of nitric oxide on red blood cell deformability. Am J Physiol Heart Circ Physiol 2003;284:H1577–84.
[7]. Hardeman MR, Goedhard PT, Dobbe JGG, Lettinga KP. Laser-assisted optical rotational cell analyzer (LORCA). 1. A new instrument for 113 measurement of various structural hemorheological parameters. Clin Hemorheol 1994;14:605–18.
[8]. Baskurt OK, Meiselman HJ. Analyzing shear stress-elongation index curves: comparison of two approaches tosimplify data presentation. Clin Hemorheol Microcirc 2004;31:23–30.

[9]. Baskurt OK, Meiselman HJ, Kayar E. Measurement of red blood cell aggregation in a ‘‘plate-plate’’ shearing system by analysis of light transmission. Clin Hemorheol 1998;19:307–14.
[10]. Baskurt OK, Bor-Ku¨ c¸ u¨ katay M, Yalcin O, Meiselman HJ, Armstrong JK. Standard aggregating media to test the ‘‘aggregability’’ of rat red blood cells. Clin Hemorheol Microcirc 2000;22:161–6.
[11]. Hofstra TC, Kalra VK, Meiselman HJ, Coates TD. Sickle erythrocytes adhere to polymorphonuclear neutrophils and activate the neutrophil respiratory burst. Blood 1996;87:4440–7.
[12]. Boyum A. Separation of leukocytes from blood and bone marrow. Scand J Clin Lab Invest 1968:(Suppl 97):7.
[13]. Tsikas D. Analysis of nitrite and nitrate in biological fluids by assays based on the Griess reaction: appraisal of the Griess reaction in the L-arginine/nitric oxide area of research. J Chromatogr B Analyt Technol Biomed Life Sci 2007;851:51–70.
[14]. Renoe BW, McDonald JM, Ladenson JH. The effects of stasis with and without exercise on free calcium, various cations, and related parameters. Clin Chim Acta 1980; 103:91–100.
[15]. Nazziola E, House SD. Effects of hydrodynamics and leucocyte-endothelium specificity on leukocyte-endothelium interactions. Microvasc Res 1992;44:127–42.
[16]. Kuhnle GE, Kuebler WM, Groh J, Goetz AE. Effect of blood flow on leukocyte-endothelium interaction in pulmonary microvessels. Am J Resp Crit Care Med 1995;

1.**Dr.V.Nagarajan,M.D.,D.M(Neuro)** Ph: 0452-2629629 Cell No.9843052029 nag9999@gmail.com.	Professor of Neurology (Retired) D.No.72, Vakkil New Street, Simmakkal, Madurai -1	**Chairman**
2.**Dr.Mohan Prasad, MS.M.Ch.** Cell.No.9843050822 (Oncology) drbkcmp@gmail.com	Professor & H.O.D of Surgical Oncology (Retired) D.No.32, West Avani Moola Street, Madurai.-1	**Member Secretary**
3.Dr.K.Parameswari, MD(Pharmacology) Cell No.9994026056 drparameswari@yahoo.com.	Director of Pharmacology Madurai Medical College.	**Member**
4.Dr.S.Vadivel Murugan, MD., (Gen.Medicine) Cell No.9566543048 svadivelmurugan_2007@rediffmail.com.	Professor & H.O.D of Medicine Madurai Medical College	**Member**
5. Dr.L.Santhanalakshmi, MD (Physiology) Cell No.9842593412 dr.l.santhanalakshmi@gmail.com.	Vice Principal, Prof. & H.O.D. Institute of Physiology Madurai Medical College	**Member**
6.Dr.A.Sankaramahalingam, MS., (Gen. Surgery) Cell.No.9443367312 chandrahospitalmdu@gmail.com	Professor & H.O.D. Surgery Madurai Medical College. Madurai	**Member**
7.Mrs.Mercy Immaculate Rubalatha, M.A., Med., Cell.No.9367792650 lathadevadoss86@gmail.com	50/5, Corporation Officer's Quarters, Gandhi Museum Road, Thamukam, Madurai-20.	**Member**
8.Thiru.Pala.Ramasamy, B.A.,B.L., Cell.No.9842165127 palaramasamy2011@gmail.com	Advocate, D.No.72,Palam Station Road, Sellur, Madurai-20.	**Member**
9.Thiru.P.K.M.Chelliah, B.A., Cell No.9894349599 pkmandco@gmail.com	Businessman, 21 Jawahar Street, Gandhi Nagar, Madurai-20.	**Member**