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Does the systemic rise in serum lactate levels correlate to free flap failure in head and neck reconstructive surgeries—series of cases

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Abstract

Background Head and neck reconstructive surgeries needs free tissue transfer but it fails sometimes. As most of the flap failure occurs in first 24 h. Local rise in lactate level or glucose lactate ratio provides clear indicator of tissue ischemia and further recovery. The question is about systemic rise in lactate levels with failing flap. Hence, we aimed to use systemic lactate levels to indicate free flap failure. To correlate the systemic rise in serum lactate levels to free flap failure in head and neck reconstructive surgeries. The series of cases were targeted undergoing free fibular graft, posted electively for head and reconstructive surgery operated by same surgeon. Record of blood loss, need of blood transfusion and use of microspan was also done. Monitoring of arterial blood gas values mainly lactate and vitals were done.

Results Out of 15 patients studied, only 2(13.3%) patients had flap re-exploration (group F). Twelve (80%) patients were of ASA class I. Lactate, pH, blood sugars, base deficits and hemoglobin and vitals studied over 24 h in two groups had no statistically significant difference in the two groups. Lactate rise was noted in all cases for first few hours after starting surgery but elevated values were not observed during hours of flap re-exploration.

Conclusions We could not establish relation between systemic rise in lactate levels and flap re-exploration or flap failure but continuous acidosis can impact outcome. We need to be vigilant and need to have individualized approach for management.

Keywords Head and neck cancers, Free flap, Lactate

Background

Head and neck carcinomas demand reconstructive surgeries. These reconstructive surgeries needs free tissue transfer with their original blood supply from donor site to recipient site creating a free flap. Though the reported success rates of micro vascular free flap is 95% or greater (Bui et al. 2007), intraoperative evaluation of flap perfusion can further improve outcome. The current indicators used to assess flap success are clinical parameters in the form of color, temperature and turgidity and many different techniques. Lactate rise is reliable indicator of tissue hypoxia and anaerobic metabolism (James et al. 1999). Local rise in lactate level or glucose lactate ratio provides clear indicator of tissue ischemia and further recovery, which is done by online rapid sampling micro dialysis (rsMD) using enzyme based electro analysis for dynamic detection of ischemia during free flap reconstructive surgery (Rogers et al. 2013). The question is about systemic rise in lactate levels with failing flap. Does it get affected while flap perfusion is getting compromised? Hence, we

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aimed to use systemic lactate levels to indicate free flap failure.

Methods

After Institutional review Board approval, series of cases posted for free fibular reconstruction after tumor excision during 2 years (2016 and 2017) was recorded prospectively. Cases operated by same surgeon were included in study to avoid confounding bias. Patients included were ASA I to II patients posted electively for head and reconstructive surgery.

Premedication and induction protocol was followed uniformly for all cases for general anaesthesia induction (Standardized for all cases). Maintenance of anaesthesia was done by O2 + N2O + Isoflurane (1 MAC) along with fentanyl and Atracurium (1:1) infusion @12 to 14 ml/h. Lungs were ventilated with tidal volume 6–8 ml/kg + respiratory rate of 12–14/min and airway pressure targeted to P max of 15–25 cm of H2O. Ventilation parameters were managed by respective anesthesiologist according to EtCO2 values so as to get PaCO2 between 35 and 45 mmHg. Record of preoperative parameters like age, weight, height, history of smoking, diabetes, American Society of Anaesthesiologist Physical Status Classification (ASA-PS) was done.

Ringer lactate was used as a fluid of choice for maintenance and. Assessment of blood loss was done by calculating approximately from suction bottles and soaked sponges. Blood transfusion was given if hemoglobin drops less than 7 g/dl. Intraoperative record of vitals, along with temperature, urine output and lactate levels in arterial blood gas analysis (ABG) were noted over 24 h every 2 hourly. Criteria included was lactate rise more than 2 mmol/L (values more than 5 mmol/L as severe) along with continuous rise over hours of surgery till 24 h. Other ABG parameters like pH, base excess/deficit, blood sugar, and hemoglobin were also recorded 2 hourly for 24 h. In the same way total fluids used and duration of surgery, use of Microspan (dextrans used to improve flap perfusion) was recorded. Flap re-exploration in 24 h was taken as criteria for flap failure. The patients were renamed into two groups—Group F includes all the patients with flap failure, requiring re-exploration and Group N includes all the patients with a successful flap with no re-exploration in 24 h.

Sample size is the number of similar tumor cases collected in two years operated by same surgeon (2016 and 2017). This is the reason we did not mention separately The Statistical software namely SPSS 18.0, and R environment ver.3.2.2 were used for the analysis of the data. Results on continuous measurements are presented on mean ± SD (min–max) and results on categorical measurements are presented in number (%). Significance is assessed at 5% level of significance. Student's *t* test (two tailed, dependent) has been used to find the significance of study parameters on continuous scale with in each group. Student's *t* test (two tailed, independent) has been used to find the significance of study parameters on continuous scale between two groups (inter group analysis) on metric parameters.

Results

We could get total 15 cases of mandibular tumor resection and fibular reconstruction being operated by same surgeon. Out of 15 patients studied, 2(13.3%) patients had flap re-exploration (Group F). Flap re-exploration considered as flap failure-which is done in both cases in next day morning which corresponds to 18–24 h after starting case. One patient (6.7%) was diabetic. Two patients of ASA class II were hypertensive. Three patients (20%) had history of smoking. 12 (80%) patients belonged to ASA class I, 3 (20%) of ASA class II. Demographic distribution was not significant in two groups (Table 1). Duration of surgery, fluid requirement, and blood loss were not statistically significant in two groups with *p* values of 0.768, 0.211, and 0.274 respectively. Lactate rise was noted in all patients till 16th hours of surgery and the values normalized later on though difference in groups was not significant. Microspan was used in 8 patients (53.3%). Microspan distribution according to re-exploratory flap

Table 1 Comparison of demographic and study variables according to re exploratory flap failure of patients studied

Variables	Re-exploratory flap failure		Total	*P* value
	No	Yes		
Age in years	30.31 ± 12.95	21.50 ± 23.33	29.13 ± 13.87	0.423
Gender (F/M)	3(23.1%)/10 (26.9%)	1/1 (50%)	(26.7%)/11(73.3%)	0.476
Weight (kg)	56.08 ± 12.68	36.00 ± 25.46	53.40 ± 15.30	0.083 +
Duration of surgery	11.12 ± 1.73	11.50 ± 0.71	11.17 ± 1.62	0.768
Blood loss	294.62 ± 77.74	225.00 ± 106.07	285.33 ± 81.41	0.274

Note: *Group F* means re-exploratory present (flap failure)–Yes; *Group N* means no re-exploration

Table 2 Distribution of lactates and pH in groups F and N

Parameters (mean ± SD)	Group	Baseline (mean ± SD)	2 h (mean ± SD)	4 h	6 h	8 h	10 h	12 h	14 h	16 h	18 h	20 h	22 h	24 h
Lactates	Gr F	2.71 ± 1.28	3.20 ± 2.12	2.75 ± 1.76	2.00 ± 1.13	2.00 ± 1.41	2.10 ± 1.56	2.35 ± 1.76	4.12 ± 3.42	3.80 ± 3.11	3.15 ± 2.33	2.35 ± 2.61	2.30 ± 2.4	1.69 ± 1.54
	Gr N	1.53 ± 0.67	2.34 ± 1.37	3.16 ± 1.52	2.62 ± 0.92	2.43 ± 0.98	2.46 ± 0.7	2.50 ± 0.83	2.35 ± 0.75	2.16 ± 074	2.16 ± 0.90	2.01 ± 0.98	1.79 ± 0.89	1.75 ± 0.97
pH	Gr F	7.38 ± 0.01	7.36 ± 0.03	7.32 ± 0.01	7.33 ± 0.01*	7.35 ± 0.04	7.33 ± 0.01*	7.35 ± 0.07	7.41 ± 0.04	7.33 ± 0.02	7.35 ± 0.04	7.34 ± 0.11	7.35 ± 0.13	7.29 ± 0.13
	Gr N	7.39 ± 0.06	7.40 ± 0.05	7.37 ± 0.06	7.4 ± 0.05	7.40 ± 0.05	7.38 ± 0.05	7.38 ± 0.06	7.38 ± 0.04	7.39 ± 0.06	7.39 ± 0.05	7.39 ± 0.05	7.38 ± 0.04	7.40 ± 0.05

* Significant *p* value (less than 0.05)

failure of patients studied was not significant (*P* 1.000). Blood transfusion was not needed for any patient perioperative. Blood sugars—14th hour and 16th hour blood sugar were showing significant difference in two groups, but rest values were showing no significant difference in two groups. pH values were showing significant difference at 6th and 10th hour and at the same time Base deficit was found significantly more (*P* value 0.00 and 0.01 respectively) but later on no significant changes were recorded, temperature (0.575), hemoglobin (0.5), MAP (mean arterial pressure), and HR(heart rate) values were not statistically significant in two groups. Different values of lactates and pH (mean ± SD with *p* values) over 24 h is given in Table 2. On observing individual data of re-explored cases, the pH was in the range of 7.30–7.38 in both cases, lactate rise to 6 and blood sugars > 200 (maximum value was 306 mg/dl at 14th hours) in one case of F-group.

Discussion

Head and neck reconstructive surgeries are challenging procedures as we need to have good functional and also cosmetic outcomes. Multiple causes have been mentioned to lead to flap failure. Mainly vascular factors are common causes of flap failure and in that venous thrombosis is commonest (Adams 2003; Novakovic et al. 2009). Early detection of this can definitely improve the outcome. Numerous ways have been defined to assess the flap function and monitor it postoperatively. The implantable Doppler probe is the technique of choice to monitor free flap over clinical monitoring. One of the different methods described is free flap glucose and lactate levels, which is cheap, simple, and rapid method of predicting microvascular complications in free flaps. But evidence of studies and their use is lacking (Chen et al. 2012). Even repeated sampling from local site is cumbersome. For the same reason, we assessed systemic rise but failed to show any correlation. Initial rise of lactate was there in all cases but systemic lactate was not statistically significant in F group, specifically during those hours when re-exploration was done, but it has been observed that few readings in one case of F group was high while in other case no such rise was observed. Initial rise may be due to various mechanisms which have been described in previous studies (Waters et al. 1999; Quinn and A, Fletcher S.J. 2019; Rajan et al. 2017). Our results are similar with previous study results where ringer lactate use has attributed to lactate rise during first 8 h of surgery. In our study, we used ringer lactate as fluid of choice and this may be the reason or may be anesthesia-related lactate rise during initial hours of surgery in both groups as there was no difference in fluid management and hemodynamics in two groups.

Numerous studies have shown that there are some risk factors for flap failure. The local rise of lactate, blood sugar, and fall in hemoglobin, acidosis, and hypothermia are some of them. In our study, we also could get acidosis in group F cases, sugar rise in one case and lactate rise in another case of Group F. So the individualized identification of risk factors is required to assess flap prognosis. The literature also proved that the risk factors of the patient did not increase the complications of a free flap transfer (Lim et al. 2014) and even older patients can tolerate free flap reconstruction with favorable long-term outcomes (Wester et al. 2013). In our study, we could not establish any relation between the use of dextran and flap re-exploration. As literature already told us that dextran is not useful as a postoperative antithrombotic agent in head and neck oncologic reconstruction with free tissue transfer but still used where vessels are not good (Jayaprasad et al. 2013). In this study, it was surgeons decision to use dextran in few cases, may be based on vessel condition.

Conclusions

We could not establish relation between systemic rise in lactate levels and flap re-exploration or flap failure but continuous acidosis was observed which could impact outcome. We need to be vigilant and need to have individualized approach for management.

Limitations

Limited data, so need to study a number of cases to get better correlation.

Abbreviations

ASA	American Society of Anaesthesiologist classification
HR	Heart rate
MAP	Mean arterial pressure
ABG	Arterial blood gas analysis

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Authors' contributions

All authors contributed to this manuscript conception and design. The first draft was written by Sapna Annaji Nikhar and all authors commented on previous versions of the manuscript. The final manuscript was read, edited, and approved by all authors.

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Availability of data and materials

The relevant data of the mentioned case is stored in computer with corresponding author. It can be made available on reasonable request.

Declarations

Ethics approval and consent to participate

The study was approved by NIMS (Nizam's Institute of Medical Science) institutional ethics committee. Letter no is as mentioned - EC/NIMS/1753/2016, PBAC No. 1147/16. Written informed consent was obtained from all patients

before starting of the surgery. They also gave consent to participate in the study.

Consent for publication
Not applicable as manuscript does not contain data from any individual person.

Competing interests
All authors declare that they have no competing interests.

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