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Original Research Paper

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ROLE OF FLAP BLOOD GLUCOSE MEASUREMENT IN MONITORING OF FLAPS INCORPORATING SKIN

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KEYWORDS :

INTRODUCTION

Flaps are one of the most important tools of reconstructive surgery. A careful, regular flap monitoring is required to predict the viability of flap. Early detection of compromised perfusion provides options to correct problems and to save a flap. Ideal flap monitoring system should be simple, reliable, reproducible and sensitive Direct clinical observation is still the gold standard monitoring system. Assessment of flap skin colour and its comparison with adjacent normal skin is a valuable indicator of flap viability. The most reliable clinical indicator of flap status is the colour of blood that oozes from the flap on pricking with a needle. Bright pink oozing represents a healthy flap, whereas dark purplish oozing reflects compromised perfusion of flap. Among other monitoring methods flourescein has long been used to assess the skin perfusion[1-2]. Another commonly used method is surface temperature monitoring to assess flap viability[3]. Conventional Doppler ultrasonography is one of the simplest and commonly used methods for evaluation of blood flow in flaps[4]. Photoplethysmography and Near-infrared spectroscopy are other methods of flap monitoring, but none of them is commonly used in clinical settings. Measurement of various aspects of flap metabolism have been utilised for monitoring of flaps, in different methods. Measurement of transcutaneous oxygen tension is one of the oldest methods of assessing flap viability.[6]This method is, however subject to many other systemic factors affecting oxygen transport and tissue oxygenation. Continuous pH monitoring is another method of assessing metabolic function in flaps. A rapid fall in pH is suggestive of anaerobic metabolism in flap due to vascular compromise. [7]

Soon after vascular compromise anaerobic metabolism starts in flaps, leads to fall in pH, increase in pyruvate level and fall in glucose level in flap. Glucose level measurement can also be used as monitoring of flap metabolism. In our study we measured flap blood glucose level with glucometer and correlate it with clinical changes of flap.

AIMS AND OBJECTIVES

1. To study blood (capillary) glucose levels in flaps incorporating skin in comparison to control site.
2. To correlate flap blood glucose level with clinical changes in these flaps.

METHODS AND MATERIAL

33 patients, operated for reconstruction with flap incorporating skin in Dept. of Burns, Plastic and Maxillo-facial surgery, Safdarjang hospital has been included in this study. Out of these, 28 patients were male and 5 were female.

Out of 33 patients two patients were operated twice, hence total number of flaps were 35. Among these flaps 31 were pedicled and 4 were free flaps.

INCLUSION CRITERIA

Age – 12yrs to 60yrsProcedure-reconstruction with flaps incorporating skin paddle (including cutaneous , fasciocutaneous, myocutaneous and osseomyocutaneous flaps)

EXCLUSION CRITERIA

Age < 12yrs; >60yrs

Patients with medical illness such as Diabetes, Hypertension, Chronic smokers.

SAMPLING TECHNIQUE

Capillary blood sample has been taken by pin prick method at the distal most part of flap. In case of below normal blood glucose or clinical signs of ischemia in distal most part of flap, blood glucose level has been measured in middle 1/3 & proximal 1/3 of flap. At the same time blood glucose level has been measured from adjacent normal skin (control site). Sample has been taken at immediate post op ,1hr after operation,6hr after operation, 12hr after operation,24hr after operation, 48hr after operation and 72hr after operation

RESULT AND STATISTICAL ANALYSIS

Out of 35 flaps, 29 flaps (203 readings were taken) have done well and no sign of ischemia was found in these flaps. Flaps blood values were slightly lower than body blood glucose value with a mean of 88.90%.

Among 35 flaps 6 flaps (16 readings were taken) have shown signs of ischemia clinically at some points. Blood glucose values of ischemic flaps were significantly low with a mean value of 35.81%.

Blood glucose level in normal flap initially declined slightly in comparison to body glucose level, but show rising trends later on. In contrast ischemic flap showed continuous decline in blood glucose level. (fig)

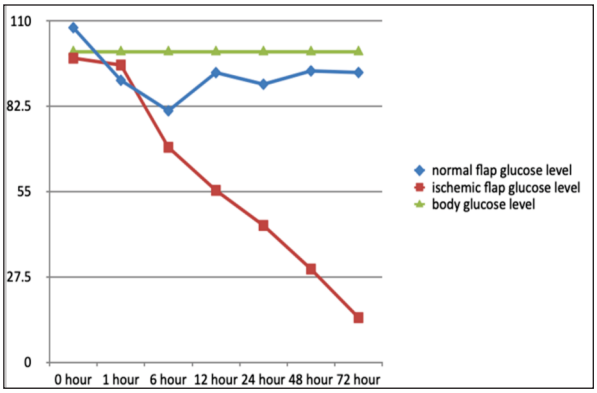

Fig. Correlation of ischemic and healthy flaps glucose levels as percentage of body blood glucose levels.

Student t-test was used to compare blood glucose level of ischemic flap with normal flaps.The mean blood glucose level in congestive or ischemic flaps were significantly lower than the healthy flaps.

	Number	Mean	Std. Deviation	Std. Error	95% confidence interval for mean	
Congested points	16	35.81	13.3374	3.334	Lower bound 28.71	Upper bound 42.92
Healthy points	203	88.90	11.3290	.7591	87.34	90.47

*The mean difference is significant at the 0.05 level

Receiver operating curve (ROC) analysis (fig) was used to determine a cut-off value of 62% of body blood glucose, at which the sensitivity and specificity were 100% and 99% respectively. The characteristics of other cut-0ff values are shown in table.

Cut off value (% of body blood glucose level)	Sensitivity (%)	Specificity (%)
58	93	99
62	100	99
70	100	95
75	100	90

Table.Various cut-off values and their sensitivities and specificities.

DISCUSSION

The results of our study show that blood glucose level is reduced significantly in congested or ischemic flaps. The fall in blood glucose correlate well with clinical changes in flaps. BGM is an easy-to-use and efficient adjunct for monitoring postoperative blood flow in flaps and may help in determining whether rescue of the flap is needed.

In our study we have also found low blood glucose level in clinically congested flaps. We had found significant decrease in BGM of congested flaps in comparison to normal flaps.

On the basis of ROC analysis, we suggest a cut-off value for flap BGM of 62% of control site blood glucose measurement (BGM). At this value sensitivity and specificity were 100% and 99% respectively. As BGM has been taken as percentage of control site BGM, its fluctuations with very high or low body blood glucose level are not expected. Its resistance to fluctuate with body blood glucose level make percentage BGM more valuable and even it can be used in diabetic patient, though diabetic patient has not been included in this study.

The mechanism involved in the reduction of blood glucose is unclear, but results in animal studies suggest two mechanism-shortage of blood supply and anaerobic metabolism of flap.

Both venous congestion and ischemia reduces blood supply to the flap, which causes a shortage of glucose supply and leads to a hypoglycaemic state in flaps. In addition, decreased blood supply to flap causes hypoxia, which results decline in aerobic metabolism and increase in anaerobic metabolism. Acceleration of anaerobic glycolytic pathway augments flap hypoglycaemia and increases lactate production. This proposal is supported by the fall in the blood glucose level and the faster rise in the lactate level in ischemic conditions in experimental studies.

In this study one flap has been salvaged with early intervention (re-exploration and revision of anastomosis of veins) on the basis of low BGM, though clinical parameters were not clearly suggestive of ischemia.

All above mentioned things suggest early fall of BGM than onset of clinical signs of ischemia/congestion. On the basis of our study exact difference between fall in BGM and onset of clinical signs can't be commented as BGM monitoring was not continuous. Though continuous blood glucose monitoring can be an ideal monitoring method but its practical applicability is questionable.

Multiple puncture for BGM assessment can be hazardous for flaps though no flaps were lost in our experience by this method. In this study depth of puncture was restricted up to dermis level, hence safety of flap ensured.

The BGM method described here is simple and can be performed by residents, nurses, and patients themselves by using the current flap monitoring instruments. Being a quantitative method BGM has no subjective variability as in clinical monitoring methods hence especially useful for learners.

CONCLUSION

At the basis of this study it can be concluded that –

1. Blood glucose levels of flaps decrease significantly in case of congestion or ischemia of flaps and correlate well with clinical changes and can be used as an early indicator of flap ischemia and provide opportunity to salvage flaps.
2. Blood glucose measurement (BGM) is an easy, accessible, easy to use by residents or staff nurse in wards and objective method of flap monitoring, and combination of BGM with clinical monitoring methods is likely to reduce postoperative complications of flap congestion.

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