

# Assessment of serum cortisol, malondialdehyde and free fatty acid levels in pre- and post-operative stress

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## Abstract

The stress responses are the hormonal and metabolic changes which occur following injury or trauma. This is part of the systemic reaction to injury which encompasses a wide range of endocrinological, immunological and haematological effects. The present study was conducted to evaluate the serum cortisol, malondialdehyde (MDA) and free fatty acid (FFA) levels in pre and postoperative surgical patients. For the present study, 25 patients admitted in surgical ward for different surgeries were selected. The serum cortisol is estimated by enzyme-linked immunosorbent assay and serum MDA and FFA was estimated by spectrophotometer. On comparative evaluation, there was highly significant decrease ( $P < 0.001$ ) in the serum cortisol, MDA and FFA levels in the postoperative surgical patients as compared to their preoperative levels. Therefore, from the present study, it could be suggested that serum cortisol, MDA and FFA are associated with the pre and postoperative stress conditions.

**Key words:** Free fatty acids, malondialdehyde, pre and postoperative stress, serum cortisol

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## INTRODUCTION

Surgical stress is the systemic response to surgical injury and is characterized by activation of the sympathetic nervous system, endocrine responses as well as immunological and hematological changes, which result in increased morbidity and mortality throughout world. The stress response to surgery comprises a number of hormonal changes initiated by neuronal activation of the hypothalamic-pituitary-adrenal axis. The overall metabolic effect is one of catabolism of stored body fuels. Surgery is one of the most potent activators of ACTH and cortisol secretion, and increased plasma concentrations of both hormones can be measured within minutes of the start of surgery. Cortisol has complex metabolic effects on carbohydrate, fat and protein. It promotes protein breakdown, and gluconeogenesis in the liver. Glucose use by cells is inhibited, so that blood glucose

concentrations are increased. Cortisol promotes lipolysis, which increases the production of gluconeogenic precursors from the breakdown of triglyceride into glycerol and free fatty acids.<sup>[1]</sup> Malondialdehyde (MDA) level, is a very useful indicator of lipid peroxidation occurring under oxidative stress. The plasma MDA concentration is frequently used as a biomarker for an overall lipid peroxidation and decrease in the post-surgical period, whereas the catalytic activity of the primary antioxidant enzyme superoxide dismutase (SOD) was increased, both indicating a relative lowering of oxidative stress.<sup>[2,3]</sup> The stress in surgical patients is still very little studied in western India. Moreover, the influence of surgical stress on the alteration of these parameters is also studied inadequately. Therefore, the present study is an effort to investigate serum levels of cortisol, MDA and free fatty acids (FFA) in pre-operative and post-operative patients.

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## MATERIALS AND METHODS

For the present study 25 patients admitted in surgery ward, C U Shah Medical College and Hospital for different surgeries were selected. Written consent was taken from all the patients and protocol was approved by institutional ethics committee. All the patients are undergoing routine

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surgical intervention. Complete history and physical examination and organ function tests were performed prior to inclusion into the study. Those patients who showed evidence of gross organ dysfunction, which may influence the postoperative recovery, were excluded from the study. Blood samples were collected in a plain bulb before (i.e. 1-day before) and after 7 days of surgery for estimation of serum cortisol, MDA, and FFA. The serum cortisol is estimated by enzyme-linked immunosorbent assay kit method, serum MDA is estimated by Tiyagi A *et al.*<sup>[4]</sup> and serum FFA is estimated by Bergmayer method.<sup>[5]</sup> All parameters levels were represented as mean  $\pm$  standard deviation (SD) and were analysed statistically using patient *t*-test. Standard error was calculated from the mean and SD of each group. Difference in levels were considered to be significant if  $P < 0.05$ .

## RESULTS

Table 1 shows the Mean  $\pm$  SD of various parameters studied in the pre- and the post-operative surgical stress patients. There was significant decrease ( $P < 0.001$ ) in the serum cortisol, MDA and FFA in the postoperative condition as compared to the preoperative levels in these surgical patients.

## DISCUSSION

There is broad range of hormones or endocrine systems concurrently responding to stress, as a result of a complex neuroendocrine effector response. These responses are elicited by large number of stimuli such as fear, anxiety, physical trauma, pain, fever, malnutrition, infection, drugs etc., the perception of which involves activation of adrenergic, cholinergic, serotonergic receptors in hypothalamus causing release of corticotrophin releasing factor.<sup>[6]</sup> Blood samples of 25 pre- and post-operative surgical patients were collected and analyzed to determine the level of serum MDA, cortisol and FFA. MDA was determined as the main parameter indicating the degree of lipid peroxidation caused by oxidative stress. Quantitative changes of all parameters mentioned before and after surgery are summarized in Table I. In our study, we reported that the

levels of serum MDA, cortisol and FFA were decreased after seven days of surgery. The above results are in agreement with previous studies, showing surgical stress induced alteration of antioxidative and immune system parameters.<sup>[3]</sup> The decrease of serum MDA and cortisol level could indicate the tendency of a lower oxidative stress in the post-surgical period.<sup>[7]</sup> Cortisol is a steroid hormone that is produced in the cortex of adrenal gland located on top of each kidney.<sup>[8]</sup> Energy regulation and mobilization are two critical functions of cortisol.<sup>[9]</sup> Cortisol regulates energy by selecting the right type and amount of substrate (carbohydrate, fat or protein) that is needed by the body to meet the physiological demand that is placed upon it. Cortisol mobilizes energy by trapping into body's fat stores (in the form of triglycerides) and moving it from location to another, or delivering it to hungry tissue such as working muscles.<sup>[10]</sup> The stress response to surgery is characterized by increased secretion of pituitary hormones and activation of the sympathetic nervous system. The stress response to surgery is characterized by increased activation of sympathetic nervous system and secretion of pituitary hormones. All tropic hormone act on corresponding target organ which further secretion of catabolic hormone and changes is increased metabolic effect as a result increased energy production and cardiovascular homeostasis. MDA is a lipid peroxidation product. Any inflammation generally causes damage to the membranes polyunsaturated fatty acid leading to generation of MDA.<sup>[12]</sup> The present study suggests that the serum cortisol may contribute to the preoperative stress conditions in these surgical patients.

## CONCLUSION

In the present study, the levels of serum MDA, cortisol and FFA were decreased after seven of surgery compared to their pre-operative levels. Therefore, from the results of the present study it could be suggested that serum MDA, cortisol and FFA levels may contribute to the pre-operative stress condition in these surgical patients.

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**Table 1:** Comparative levels of serum cortisol, MDA and FFA in pre- and post-operative stress of surgery (n=25)

| Parameters             | Mean $\pm$ SD  |               | P      |
|------------------------|----------------|---------------|--------|
|                        | Preoperative   | Postoperative |        |
| Serum cortisol (ng/mL) | 242.3 $\pm$ 49 | 97.4 $\pm$ 54 | <0.001 |
| Serum MDA (nM/L)       | 8.6 $\pm$ 2.7  | 4.2 $\pm$ 2.3 | <0.001 |
| Serum FFA ( $\mu$ M/L) | 811 $\pm$ 104  | 600 $\pm$ 100 | <0.001 |

\* $P > 0.05$ : Not significant,  $P < 0.05$ : Just significant,  $P < 0.01$ : Significant,  $P < 0.001$ : Very significant. SD: Standard deviation, MDA: Malondialdehyde, FFA: Free fatty acid

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