FIG. 1 - THE ENERGY METABOLISM.
INTRODUCTION

"We have observed from the standpoint of anaesthesia that a curve of reflex irritability follows a course parallel to that of metabolism. Cell oxygen demand, of course, is the same curve as that of metabolism".

Arthur Guedel, 1924.

Everything under (and over) the Sun has a darker side (similar to the other side of a coin) and anaesthesia is no exception.

The never-ending human quest towards minimizing the mortality and morbidity in seriously ill or traumatized patients has resulted in more and more attention being paid to the metabolic stability. Proper maintenance of the metabolic needs of the patient has emerged as perhaps the single most important factor in improving the chances of survival in such patients.

The giant strides made in the field of anaesthesiology in the current century, render a whole spectrum of agents and techniques to the modern anaesthetist for providing excellent operating conditions. But even in the present era of "balanced anaesthesia", almost all anaesthetic agents, whether intravenous or inhalational, extol their price by producing variable but significant derangements in the metabolic homeostasis. In the past, everyone was sceptical of anaesthesia in the mistaken notion that it alone is responsible for causing all the metabolic upset, but recent sophisticated techniques and interpretation of earlier data in the right perspective have helped the anaesthetist to breathe easy, while the surgery itself has come in for some really nasty criticism for being the real culprit.

The metabolism, at its simplest form, consists of supply of metabolic fuels and their conversion into chemical energy for cellular...
FIG. 2 - THE ENDOCRINE RESPONSE TO TRAUMA

The usual metabolic response to major accidental/surgical trauma includes an initial phase characterized by the catabolic hormones. Adaptation occurs after 3 - 5 days.
functions, the various fuels being carbohydrates (glucose, fructose and galactose), lipids (mainly triglycerides) and proteins (alanine and glutamine).

The human metabolism is peculiar in that some tissues (red blood cells) are totally dependent while others (brain and renal cortex) are partially dependent upon glucose for energy production, therefore blood glucose concentration needs to be maintained within relatively narrow limits. On the other hand, the total carbohydrate reserve of the body is less than even a single day's basal metabolic requirement.

Glucose, being the most active fraction of carbohydrates, is utilized by the tissues for energy production. Upto mild degree of stress or exercise, glucose alone may meet the energy demand, but beyond certain limits the fatty acids activity comes into play to meet the additional requirement for energy production. A fall in the blood glucose concentration results in lipolysis and free fatty acids (FFA) are released in the blood. This FFA fraction, though only 5% of total plasma fatty acids, has a very rapid turnover rate. The FFA are carried in the plasma as an "Albumin-FFA complex" to the tissues for energy production.

Immediate survival of body in acute stress-situations may well depend upon how much and how rapidly the body can mobilize its metabolic resources. Anaesthesia is one acute clinical stress of iatrogenic origin, which affects carbohydrate and lipid metabolism to a variable degree.

Surgery is another step ahead. Any surgical trauma in itself causes profound changes in metabolism; while a combination of previous injury, surgical trauma and anaesthesia results in profound and long-lasting metabolic changes, the most apparent being the hyperglycemia. The extent of this hyperglycemia is a crude but effective indicator of the stress-response shown by the body. The duration of anaesthesia and surgery also affects the degree of metabolic mobilization and hyperglycemic response.
FIG. 3 - METABOLIC FUEL REGULATORY SYSTEM

Arrows indicate how the metabolic fuels and insulin influence each other's concentration in blood. The metabolic pathway for the oxidative degradation of the various fuels lead to common terminal events. The oxidation of metabolic fuels occurs in an integrated fashion, so that the total energy generated is equal to the energy expenditure (ATP/ADP) ratio.
Fig. 4 - The adrenal medulla is stimulated to release adrenaline into the blood by signals from the central nervous system. Adrenaline activates adenyl cyclase, which catalyzes cAMP. Cyclic AMP triggers the actions of phosphorylase a and hormone sensitive lipase which results in conversion of glycogen into glucose and triglyceride into FFA. A little adrenaline has a large effect according to Rube Goldberg sequence.
The hyperglycemic response seen during and after injury, anaesthesia and surgery is on account of increased glycogenolysis and gluconeogenesis (i.e., endogenous glucose production from non-carbohydrate substrates).

The levels of glucose and FFA in the blood and their inter-relationship reflects the degree of hyperglycemic - hyperdynamic metabolic response which in its turn is directly proportionate to the degree of stress, which the body is undergoing at that time; therefore circulating concentrations of glucose and FFA in blood help to assess the degree of stress, which the patient undergoing anaesthesia and surgical trauma is subjected to.

The present study aims at studying the alterations in blood sugar level (a good parameter to judge extent of carbohydrate metabolism) and plasma FFA (most active fraction of fatty acids and with a very rapid turnover rate, hence a good parameter to judge extent of lipid metabolism) during inhalational anaesthesia with and without surgery and to assess the various inhalational anaesthetic agents in relation to the changes in these parameters.