Stress Response in Pediatric Anesthesia.

Comparative Study on General Anesthesia Versus Combined General and Caudal Epidural Anesthesia for Abdominal Surgery

Thesis Submitted for Partial Fulfillment of the M.D. Degree in Anesthesia

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Contents

Introduction

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The function of the sympathetic nervous system is to maintain physiological stability in the face of a changing environment, where it controls and modifies body function as cardiac performance, circulation, ventilation, digestion, metabolism of fats and carbohydrates, and temperature. However, when such a change constitute a threat, the response of the sympathetic nervous system is massive, affecting all functions in a global re-arrangement of physiologic priorities for either defense or escape. Historically, the response of the sympathetic nervous system was the first to be recognized and labelled the stress response ***(Roizen, 1990).***

During anesthesia and surgery, there are many stressful stimuli as pain, hemorrhage, tissue damage, infection, anxiety, and anesthetic techniques. The body responds to trauma or surgical stress in a characteristic fashion. It represents a pattern of physiologic adaptations designed to return the host to normal function. This defensive mechanism is considered as a normal stress response which is characterized by a neuroendocrinal –sympathetic response coordinated by the central nervous system ***(Michie and Wilmore, 1990).***

Surgical trauma and tissue damage are accompanied by activation of hypothalamo – pituitary – adrenal (HPA) axis. This is manifested by a release of trophic hormones from the hypothalamus which in turn stimulate release of adrenocorticotropic hormone (ACTH), thyroid – stimulating hormone (TSH), growth hormone (GH), follicle – stimulating hormone (FSH), lutenizing hormone (LH), prolactin and antidiuretic hormone (ADH) from the pituitary. Consequently, there is increased secretion of cortisol and thyroxin with suppression of insulin and increase in blood sugar concentrations ***(Kaufman, 1984).***

In addition, increased hypothalamic activity induced by nociceptive stimulation is accompanied by increased traffic in sympathetic efferent tracts. Increased sympathetic tone involves augmented release of noradrenaline by sympathetic fibers and also increased secretion of catecholamines from the adrenal medulla ***(Brown et al., 1982).***

These responses are helpful in an injured person, but there is evidence that a severe and prolonged catabolic reaction to injury may be associated with an increased morbidity in high – risk patients. The infants and children's reserves of carbohydrate, fat and protein are limited at a time when they have to meet the metabolic coasts of rapid growth and organ maturation. For these reasons the pediatric response to surgery must be different from that of the adults ***(Hamit et al., 1995).***

Studies on infants and children have demonstrated that inadequate analgesia or anesthesia may result in a massive stress response which is manifested by release of catecholamines and catabolic hormones. Peak adrenaline concentrations in infants and children have been found greater than those in adult studies. Adrenaline concentrations usually diminish by one hour after surgery and become close to base line values within 24 hours. This is in contrast with adults where catecholamine concentrations continue to increase after surgery and support the view that stress responses in infants and children are greater in magnitude but of shorter duration than those of adults ***(Wolf et al., 1993).***

Perioperative circumstances usually expose the child to series of stressful events which are responsible for development of that stress response. Preoperative anxiety, fear, starvation, critical illness, burn and infection constitute the most common causes of preoperative stress. Also, anesthetic and surgical factors like tracheal intubation, surgical trauma and hemorrhage are the most significant stressful stimuli. Infants and children usually develop postoperative hypothermia and pain associated with increased neuro-endocrine activity.

It is possible to modify the neuro – endocrine response to anesthetic and surgical stress in children either by interrupting the afferent pathway with local anesthetic techniques, or by inhibition of hypothalamus with large doses of opioids. Unfortunately, effective ablation of the stress response to major surgery requires doses of opioid far greater than that needed to provide analgesia and necessitates postoperative ventilation. This is impractical for most infant surgeries, and opioids are limited usually to doses which allow immediate postoperative extubation ***(Wolf et al., 1993).***

In children, lumbar and caudal extradural blocks with local anesthetics can abolish or reduce the increase in cortisol and catecholamines in response to inguinal herniorraphy, orchidopexy and hypospadius repair ***(Murat et al., 1988).***

Premedications and different anesthetic regimens have been used in attempt to ablate or attenuate the stress response of anesthesia and surgery, with the aim to achieve or approach what is called "stress free anesthesia" ***(Cooper et al., 1981).***

The aim of this work is to evaluate the efficacy of caudal extradural analgesia in abolishing or attenuating the metabolic and neuro-endocrine responses. This is done through a comparative study between two different anesthetic techniques in children undergoing abdominal surgery. Stress response towards surgical trauma and anesthetic technique is evaluated by measurement of cortisol and growth hormone as hormonal response, blood sugar level as metabolic response, in addition to cardiovascular assessment by measurement of heart rate and mean arterial blood pressure.