

The Effect of Anesthesia on Thyroid Hormones and Cortisol Levels Following Major Urological Surgery

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Abstract:

This study was designed to evaluate the effect of anesthesia on thyroid hormones (T3, T4, rT3), thyrotropin(TSH), and cortisol levels in patients undergoing major urological surgery. The study included fifty patients scheduled for elective major urological surgery where 70% of the patients underwent general anesthesia, while 30% underwent regional anesthesia. All patients were in stable control general conditions. The study showed that the thyroid hormones, thyrotropin and cortisol levels were affected with general anesthesia more than regional. The levels of these hormones responded to anesthetics and surgical stresses. This response was thought to be mainly mediated by afferent neurogenic impulses from the area of injury. Therefore, abolition of sensory as well as autonomic afferent stimuli by neurogenic blocked types of anesthesia such as (epidural anesthesia) that may help in reducing the excretion and metabolic response to surgery.

Keywords: Major urological surgery, Anesthesia, Thyroid hormones, Thyrotropin hormone, Cortisol.

Introduction:

Surgical intervention is resulting in changes in neuroendocrine regulation, metabolism and physiological functions, as part of the response to stress [1,2]. There is a main method for the modification of the endocrine and metabolic responses; the application of neural blockade, to prevent the transmission of impulses from the site of trauma, that is characterized with (regional and general anesthesia). General anesthesia has a state of complete insensibility to external stimuli, which is caused by reversible depression of nerve cells. The term includes loss of consciousness, all the painful stimuli, fire defensive reflexes, and often the relaxation of skeletal muscles [3,4].

Regional anesthesia can block the sympathetic stimulation caused by surgical incision, which leads to the release of catecholamine and other hormones. Inhibition is associated with the level of neural blockade, especially in surgery of the lower abdomen and lower extremities [5]. Hormonal response in relation to regional anesthesia and general anesthesia may limit the perception of

stimuli from injury, but does not eliminate the full response to noxious stimuli, even with deep anesthesia [6]. The present study aims at demonstrating the effects of general and regional anesthesia in the changes of the levels of (T3, T4, TSH, rT3, and cortisol).

Patients and Methods:

For this study, 50 patients (males (36), and (14) females), with age range of (35-75) years (Mean±SD 57.5±11.5) were selected from the urological department of AL- Yurmok Hospital located in the city of Baghdad, Iraq during the period from December 2012 to April 2013. These patients were underwent elective major urological surgeries (such as Cystectomy, Prostatectomy, and Redo reimplantation of ureter). Patients received two types of anesthesia: 70% general and the drugs that were used are:

- Propofol, Pentothal (Intravenous anesthetic agent).
- Halothane, isoflurane (Inhalation anesthetic agent).
- Ketamine (Sedative and analgesia)

The result was 30% regional (14% spinal and 16% epidural), and its drugs: xylocaine. Exclusion criteria were infants and adolescents, pregnant, a history of thyroid disease and thyroid surgery,

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uncontrolled diabetes, uncontrolled hypertension, history of trauma, emergency cases, acute myocardial infarction, and liver disease with derangement of liver function. All patients were in stable control general conditions.

Venous blood samples were collected from each patient one day preoperative, perioperative, one day postoperative, and two days postoperative, for measuring thyroxin (T4) (Human, Germany kit), triiodothyronine (T3) (Human, Germany kit), thyrotropin (TSH) (Human, Germany kit), reverse triiodothyronine (rT3) (CUSABIO, China kit), and for measuring cortisol (Human, Germany Kit). The blood samples were collected one day preoperative, and one day postoperative. Each kit was supplied with instruction for hormone assay by ELISA (USA). Analysis of data was carried out using the available statistical package of SPSS-18 (Statistical Packages for Social Sciences –version 18 "PASW" Statistic).

Results and Discussion:

The changes in the levels of T3 and T4 were related to each type of anesthesia shown in Table and Figure (1). Their levels were increased perioperative with each type of anesthesia but more increment in with had been noticed (significant $P < 0.05$). Then it decreased after one day with each type at significant ($P < 0.05$) but more decrease with general, and it increased again after two days with each type of anesthesia, and the increase was more pronounced with general not significant ($P > 0.05$). Neuroendocrine, metabolic and inflammatory aspects of the injury are part of an overall "stress response". Metabolic and neuroendocrine response to surgical intervention depends on several factors. Such as severity of the surgical trauma, type of anesthesia and surgical techniques [7].

Table 1. Changes in serum concentration of total T4 related with anesthesia

Time of T4 measurement [N=50]	General	Regional
T4 ($\mu\text{g/dl}$) Before one day	16.01 \pm 5.57	17.48 \pm 5.31
T4 ($\mu\text{g/dl}$) perioperative	20.05 \pm 5.56	20.87 \pm 2.15
T4 ($\mu\text{g/dl}$) After one day	10.73 \pm 6.36	11.99 \pm 7.38
T4 ($\mu\text{g/dl}$) After two days	14.02 \pm 8.42	12.43 \pm 7.65
P value comparing Before x perioperative	0.006*	0.243
P value comparing Before x After 1day	0.0001*	0.025 *
P value comparing Before x After 2day	0.202	0.045 *
P value comparing perioperative x 1day	0.0001*	0.027 *
P value comparing perioperative x 2days	0.001*	0.007 *
P value comparing After 1day x 2days	0.085	0.692

$P < 0.05$ is significant

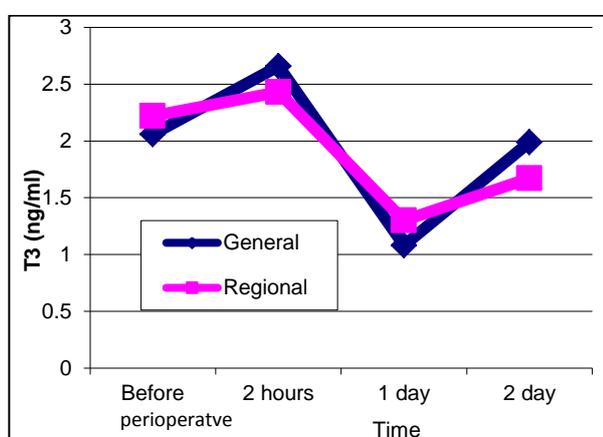


Figure 1. Changes in serum concentration of total T3 related with anesthesia

The results of the present study show that T3 and T4 levels increase perioperative comparing with preoperative value significantly with general and non-significantly with regional, their decrement levels have been noticed significantly after one day

of surgery undergoing both types of anesthesia but more decrease with general. Hideo Iwasaka et al.[8] found that T3 plasma levels decrease consistently during surgery undergoing both regional (epidural) and general (enflurane) anesthesia, and also found increase in T4 perioperative and supposed that halothane release T4 from hepatic stores. The mechanism behind this perioperative changes in thyroid hormone metabolism remains to be obscure but it might be speculated that afferent neurogenic blockade during surgery might be the cause. Ediba Celic[9] found low perioperative values of T3 in both general and regional anesthesia for patient underwent transvesical prostatectomy and lower values of T3 were continuing after 24 hours postoperatively in both applied techniques of anesthesia while the values of T4 hormone in subjects under general anesthesia do not show major deviations perioperatively or postoperatively, low perioperative values of T4 in patients with regional anesthesia with a gradual increase in the

value postoperatively. After 24 hours, the recorded value of T4 does not reach the preoperative values. While the level of TSH increased perioperative significantly ($P < 0.05$) with each type of anesthesia, more increased with general anesthesia. After one day, it decreased significantly ($P < 0.05$) with regional but not significantly with general ($P > 0.05$), and it increased again after two days significantly with general anesthesia ($P > 0.05$), as shown in Table and Fig. (2). The change in rT3 level related with anesthesia shown in Table and Fig. (3). The mean rT3 level was increased postoperatively with general and regional anesthesia not significant ($p > 0.05$). The mean cortisol concentration increased perioperative significantly ($p < 0.05$) with both general and regional anesthesia. After one day, it continued to increase significantly ($p < 0.05$) with general, but it decreased significantly ($p < 0.05$) with regional anesthesia, and after two days it decreased significantly ($p < 0.05$) with general anesthesia, but not significant with regional ($p > 0.05$) as shown in Table (4). This study agrees with Ediba Celic [9] study that reported increased perioperative levels of TSH in both anesthetic techniques, with higher maximum values in patients with the technique of general anesthesia. The values of TSH postoperatively after 24 hours show a return to baseline in case of both applied technique of anesthesia, and also found increased levels of

cortisol both perioperatively and 24 hours postoperatively for both anesthetic techniques (general and regional). AT Aggo[6] found that, a minimal rise in cortisol levels was found to be associated with the use of regional anesthesia, more than fourfold increases above the baseline levels were observed in the patients who had surgery under general anesthesia. The basic mechanism of neural blockade of stress response to surgical intervention is completely preventing pain signals from the operating field reach the CNS [10,11].

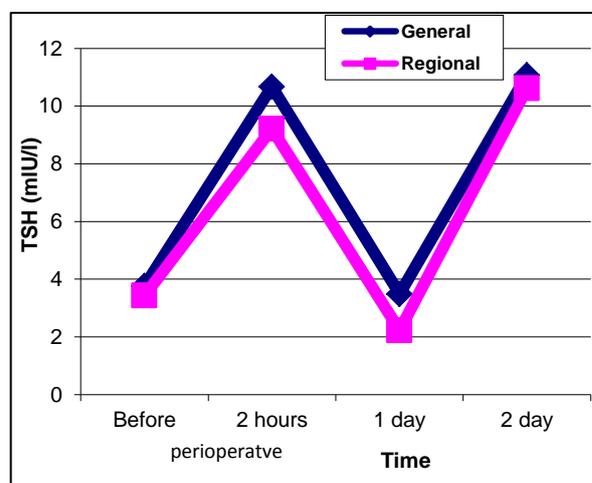


Figure 2. Changes in serum concentration of TSH related with anesthesia

Table 2. Changes in Serum Concentration of total TSH related with Anesthesia

Time of TSH measurement [N=50]	General	Regional
TSH (mIU/l) Before one day	3.77±2.07	3.43±2.58
TSH (mIU/l) perioperative	10.67±5.75	9.21±3.52
TSH (mIU/l) After one day	3.49±1.77	2.23±0.97
TSH (mIU/l) After two days	11.07±7.97	10.62±8.74
P value comparing Before x perioperative	0.0001*	0.003*
P value comparing Before x After 1 day	0.438	0.022*
P value comparing Before x After 2 day	0.0001*	0.008
P value comparing perioperative x 1 day	0.0001*	0.001*
P value comparing perioperative x 2 days	0.819	0.609
P value comparing After 1 day x 2 days	0.0001*	0.044*

P<0.05 is significant

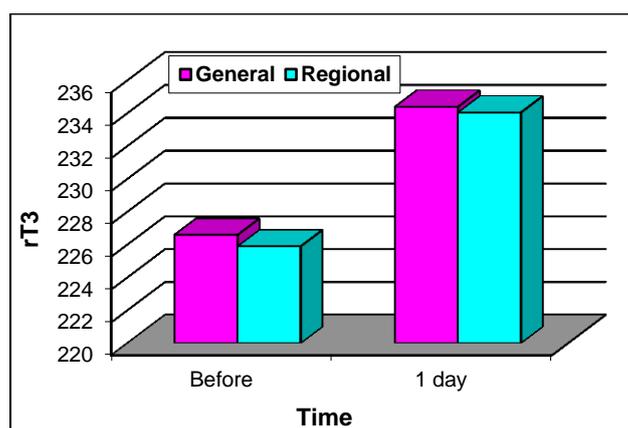


Figure 3. Changes in serum concentration of rT3 related with anesthesia

Table 3. Changes in Serum Concentration of rT3 related with Anesthesia

Time of rT3 measurement [N=50]	General	Regional
rT3 (pg/ml) Before	226.6±76.69	225.9±48.13
rT3 (pg/ml) After one day	234.4±57.61	234.05±52.16
P value comparing Before x After 1day	0.547	0.427

P<0.05 is significant

Table 4. Changes in Serum Concentration of Cortisol related with Anesthesia

Time of Cortisol measurement [N=50]	General	Regional
Cortisol (ng/ml) Before one day	90.0±37.3	85.65±21.8
Cortisol (ng/ml) perioperative	132.3±46.0	133.4±38.9
Cortisol (ng/ml) After one day	149.4±38.4	131.35±22.7
Cortisol (ng/ml) After two days	115.1±37.2	112.25±32.5
P value comparing Before x perioperative	0.0001*	0.002 *
P value comparing Before x After 1day	0.0001*	0.006*
P value comparing Before x After 2day	0.003*	0.147
P value comparing perioperative x 1day	0.038*	0.350
P value comparing perioperative x 2days	0.097	0.309
P value comparing After 1day x 2days	0.0001*	0.317

P<0.05 is significant

Conclusion:

The anesthesia had affected the hormones, and the general anesthesia had the clearest effect. Rising of rT3 in the first postoperative day, that explains the shift in conversion of T4 away from T3 and towards increased rT3 production. Hormones under hypothalamic –pituitary control was also affected by the stress of the surgery and that was reflected on TSH that increased perioperative, then it fell one day postoperative, but it returns to increase after two days of the operation. The hypothalamic-pituitary-adrenal (HPA) axis was activated leading to elevation the cortisol levels postoperatively, but it returned to preoperative value in the second postoperative day.

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تأثير التخدير على مستويات هورمونات الدرقية والكورتيزول بعد الجراحات الكبرى للمسالك البولية

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الخلاصة:

أجريت هذه الدراسة لتقييم تأثير التخدير على تغير مستويات هورمونات الدرقية والهورمون المحفز للدرقية ، والكورتيزول. ضمت الدراسة (50) مريضا خضعوا لعمليات جراحية بولية اختيارية(غير طارئة) كبرى حيث 70% من المرضى كانوا تحت تأثير التخدير العام و 30% تحت تأثير التخدير الموضعي. لوحظ ان مستويات كل من (T3, T4 TSH, and Cortisol) تأثرت بالتخدير العام اكثر من تأثرها بالتخدير الموضعي، ووجد ان مستويات هذه الهرمونات تستجيب لأجهاد الجراحة والتخدير وان هذه الاستجابة تكون بواسطة نبضات عصبية قادمة من منطقة الاصابة لذلك فأن استخدام كايح عصبي مثلا(التخدير الموضعي) للتحفيز اللاارادي قد يساعد في الحد من استجابة الغدد الصماء و التمثيل الغذائي لتأثير الجراحة.

الكلمات المفتاحية: العمليات الجراحية البولية الكبرى، التخدير، هرمونات الدرقية ، هرمون محفز الدرقية والكورتيزول.