PERIOPERATIVE MONITORING AND ASSESSMENT OF STRESS-RELATED MARKERS IN GYNECOLOGICAL SURGERY

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Abstract

The study addressed perioperative monitoring and interpretation of stress-related markers in gynecological surgery. The study included 48 patients, divided into two groups, undergoing gynecological operations. The first group (n=26) were patients operated by open laparotomy while the second group (n=22) patients operated by laparoscopic technique. Total cholesterol, cortisol, thyroid-stimulating hormone (TSH), thyroxine (FT4) were monitored. The results showed comparable changes in the two groups, with more significant deviations from the baseline values observed in the first group.

Key words: *cholesterol, cortisol, gynecological operations*

Introduction

Each surgical intervention is associated with an increase in the levels of stress hormones. This is due to stimulation of the hypothalamic-pituitary-adrenal axis and the sympathetic nervous system. In our study, we monitored the perioperative changes in TSH, FT4, cortisol, and also cholesterol, as a precursor of steroid hormones and a major substance involved in the construction of cell membranes.

Objective

To monitor and interpret the changes of cholesterol, cortisol, TSH and FT4 in patients operated by open laparotomy and in patients operated laparoscopically.

Materials and methods

The study was conducted at Dr. Georgi Stranski University Hospital, the Oncogynecology Clinic, Pleven town, Bulgaria and consisted of 48 women undergoing gynecological operations. The patients were divided into two groups. The first group (n=26) included patients aged between 27 and 76 years, operated by open laparotomy. The second group (n=22) included patients aged between 36 and 83 years, operated by laparoscopic technique.

Anesthesia was performed to all patients in the same manner. The administered premedication was dormicum, fentanyl, atropine. Induction of anesthesia was accomplished with propofol and listenone. After induction the patients were intubated, anesthesia was maintained with sevoflurane, trachrium, and fentanyl.

Patient's blood pressure, pulse rate, ECG, saturation and the amount of carbon dioxide in exhaled air were monitored throughout the operation. For the study of total cholesterol and cortisol, blood samples were taken in the following moments: before the start of the operation (time 1); at the time of resection of the uterus, fibroid nodes, adnexa (time 2); after the end of the operation and extubation (time 3); in the morning (8-10 a.m.) of the first and third postoperative days (time 4 and 5, respectively).

For the study of TSH and FT4, blood samples were taken: before the start of surgery (time 1); after the end of the operation and extubation (time 2); in the morning (8-10 a.m.) of the first postoperative day (time 3).

To study the serum levels of cortisol, thyroid-stimulating hormone (TSH) and thyroxine (fT4), 2 ml of fresh or frozen serum, obtained by venipuncture, were used. The serum was stored at a temperature of 2º to 8ºC, and for a longer time at a temperature regime of minus 20º C.

ELISA method was used to determine the serum concentration of cortisol, TSH and fT4 (Novatec, Immunodiagnostica GmbH, Germany).

• values lower than 60 ng/ml for cortisol (in serum obtained between 8:00 a.m. and 10:00 a.m.), 0.3 µIU/ml for TSH and 7 ng/L for fT4 are considered decreased.
• values higher than 230 ng/ml for cortisol (in serum obtained between 8:00 and 10:00), 4.5 µIU/ml for TSH and 22 ng/L for fT4 are considered elevated.

A turbidimetric method was used to determine the serum concentration of total cholesterol (Hitachi-704, Japan and "Integra" - Roche Diagnostics-Germany). Results are in mmol/l.

Results

The results showed no statistically significant changes in TSH and FT4 in both groups of patients at the end of surgery and in the early postoperative period (fig.1 and fig.2).

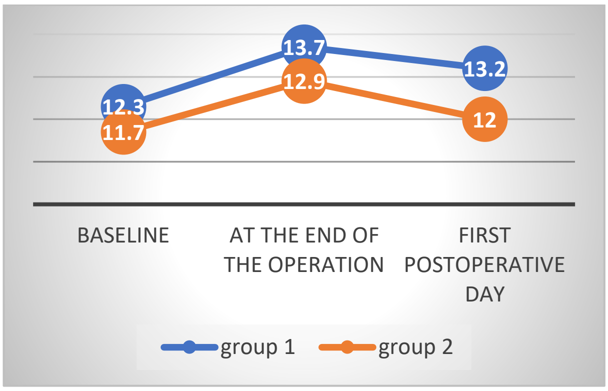

Figure 1. Changes in FT4 level in ng/L.

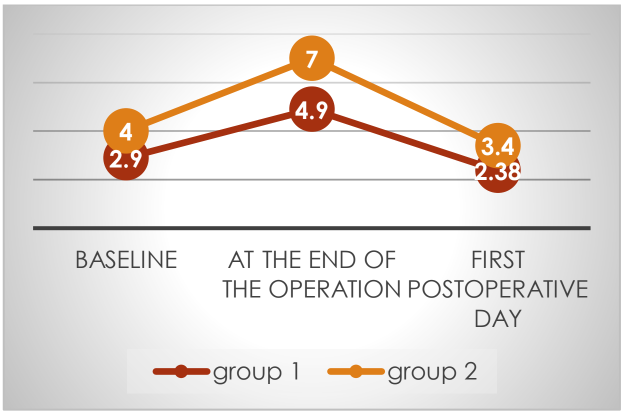

Figure 2. Changes in TSH level in µIU/ml.

Significant changes in serum cholesterol level were observed in both groups (table 1 and fig.3). In group 1, the decrease was significant from time 2 to the end of the study. In group 2, a statistically significant deviation from the initial values was measured at time 2, 3 and 4. On the 3rd postoperative day, the values were close to the initial values.

Table 1. Serum level of total cholesterol by groups at different times

	Baseline	Traumatic moment	At the end of the operation	First postoperative day	Third postoperative day
Group 1	5,63	4,56**	4,67**	4,46**	4,58**
Group 2	5,28	4,51*	4,67*	4,,43**	5,21

* t>2 (compared to time 1) p<0.05; ** t>3 p<0.03

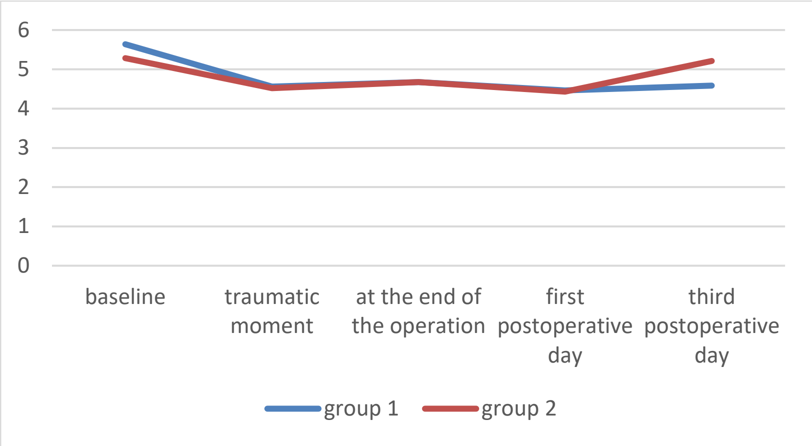

Figure 3. Changes in serum cholesterol level in mmol/l

Changes in cortisol in both groups were similar to the ones in cholesterol. In both groups, there was a statistically significant difference at time 2, 3 and 4 compared to the initial values (table 2 and fig.4). At time 5, cortisol values in both groups were close to baseline.

Table 2. Serum cortisol level by group at different times.

	Baseline	Traumatic moment	At the end of the operation	First postoperative day	Third postoperative day
Group 1	118,97	374,57**	473,47***	252 **	136,89
Group 2	192,91	457,9**	520,69**	293,44*	184,84

* t >2 p<0,05; ** t>3 p<0,03; *** t >9

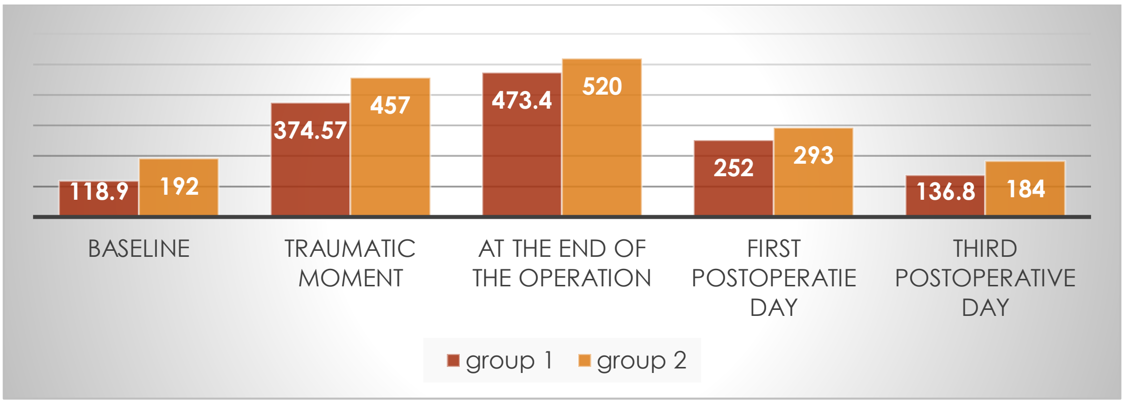

Figure 4. Changes in serum cortisol level in ng/ml

Discussion

Lowering the level of serum cholesterol during and after operative interventions has been observed and studied by many authors (1,2,3). In the perioperative period, the need for cholesterol is increased due to increased synthesis of stress hormones and new cell membranes (4).

It follows that greater tissue trauma is associated with a greater need for cholesterol for tissue repair, and also a higher level of stress hormones and the use of cholesterol for their synthesis.

When using a laparoscopic technique, the tissue trauma is less, the stress level is lower and the recovery is faster.

With open laparotomy, there is greater tissue trauma and longer recovery for patients. This is also confirmed by our results. In group 2, cholesterol and cortisol values at time 5 (postoperative day 3) were close to baseline, indicating good recovery and a smooth postoperative period.

In group 1, a tendency to increase serum cholesterol values was observed, but at time 5 (day 3) they had not yet reached baseline levels, which indicates a still ongoing recovery process (5,6,7,8). Maintaining low cholesterol levels after surgery, or if it continues to decrease after surgery, is associated with a higher likelihood of superficial and deep infections, a complicated postoperative period, and a greater risk of death (1,9,10). In one of the patients in group 1, on the second postoperative day, Burkholderia cepacia complex was isolated by blood culture. In this patient, the dynamics of cholesterol is shown in Fig. 5:

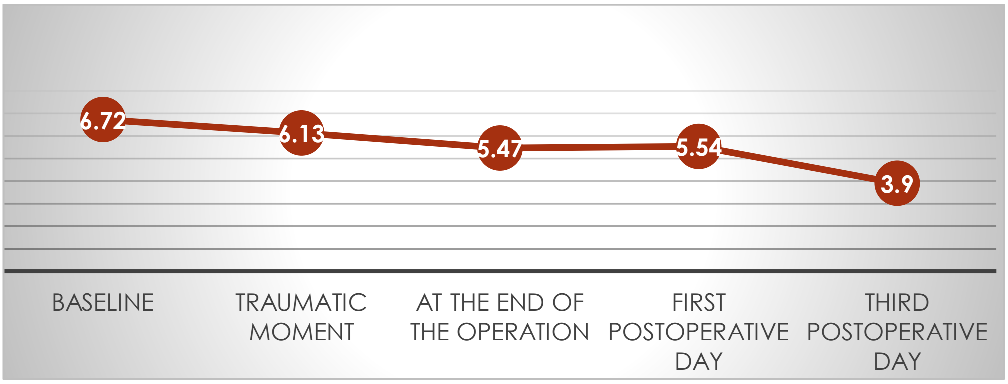

Figure 5. Patient with Burkholderia cepacia complex isolated from blood culture

It can be seen that on day 3 after surgery, cholesterol continues to decrease, which is consistent with the observations by other authors (11,12,13,14). Hypocholesterolemia is an indicator of metabolic stress response. It is often seen in intensive care patients and after surgery. It is due to impairment of lipid metabolism (15,16,17).

The liver takes part in the metabolism of cholesterol and fats. Damage to the function of the liver leads to a disturbance in their metabolism (18,19). Inhalational anesthetics affect the liver's blood supply, and may therefore affect its functions, including cholesterol metabolism. In our study, anesthesia was the same in both groups, so the possible influence of anesthesia on the parameters we are tracking will not be taken into account.

Glucocorticoids are important hormones that are associated with the survival of the body during time of stress (10). The hypothalamic-pituitary system controls their secretion. Cortisol occupies a major place among glucocorticoids and cholesterol is needed for its synthesis (4).

The biosynthesis of cortisol is "instant" - about 2 minutes after stimulation of the adrenal gland by ACTH, glucocorticoids appear in the peripheral circulation (5). When the amount of cortisol is high, it leads to less thyroid hormone production.

Thyroid hormones - thyroxine (T4) and triiodothyronine (T3) are secreted into the circulation by the thyroid gland under the influence of thyroid-stimulating hormone (TSH). In tissues, T4 (prohormone) is converted to T3, which is 3 to 5 times more active than T4 (20,21). Very small amounts of thyroid hormones that are not bound to proteins are metabolically active. These are free thyroxine (fT4) and triiodothyronine (fT3) and they are in equilibrium with protein-bound thyroid hormones.

Conclusion

Surgical intervention induces a metabolic, hormonal and hemodynamic response. It is characterized by altered protein homeostasis, hypermetabolism, altered carbohydrate metabolism, salt and water retention, and accelerated lipolysis. The magnitude of these changes is proportional to the extent of the surgical trauma and to the serum levels of stress hormones. Tracking the dynamics of total cholesterol provides information on the recovery process and can be used to predict the occurrence of complications.

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