Preoperative preparation of patients with hyperparathyroidism as comorbidity

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INTRODUCTION

Hypoparathyroidisms, both primary and secondary, are very important comorbidities in endocrine surgery. Primary hyperparathyroidism is diagnosed much more often than before since determination of calcium in serum became a routine and since the possibility to determine parathyroid hormone values became largely accessible.

Frequency of primary hyperparathyroidism is estimated to be around 1%, but the disease is fortunately asymptomatic, that is, not accompanied by clinical manifestations of importance for nonendocrine surgery. Patients with secondary hyperparathyroidism also increased in number from year to year because their life quality improved owing to better dialysis and they lived longer.

Preoperative preparation, anesthesia and immediate postoperative period in patients with hyperparathyroidism planned to be operated and/or already operated because of some other disease, are specific in function of the type of hyperparathyroidism, primary or secondary.

Repercussions of pronounced hypercalcemia on organs and systems are of essential importance. The most important aspect of preoperative preparation of these patients is therefore the treatment of hypercalcemia.

In patients with secondary hyperparathyroidism as comorbidity, calcium level is of lesser importance since it stays mostly within reference values. Essential for perioperative preparation of these patients is the fact that they have chronic renal insufficiency and usually are on extrarenal depuration, so that uremic toxic disorders important for the perioperative course should be taken into account.

Disorders caused by primary or secondary hyperparathyroidism (and terminal chronic renal insufficiency) must be brought to so-called "stable state" in elective surgical interventions. Preoperative preparation in urgent surgical interventions is focused only on vitally endangering consequences of hyperparathyroidism such as hypercalcemic crisis or extreme hyperkalemia.

Key words: primary hyperparathyroidism, secondary hyperparathyroidism, preoperative preparation, surgical treatment, anesthesia

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PREOPERATIVE PREPARATION OF PATIENTS WITH PRIMARY HYPERPARATHYROIDISM AS COMORBIDITY

Primary hyperparathyroidism’s most important characteristic is hypercalcemia; its repercussions on most organs and systems are different, which is of great importance both for preoperative preparation and choice and dosage of anesthetics and other drugs and infusion solutions, intraoperatively.

Hypercalcemia is responsible for a whole range of symptoms and signs appearing in a great number of organs and systems. Symptoms, depending on the gravity of hypercalcemia, reflect changes in concentration of ionized calcium which is a physiologically active form of calcium and represents around 45% of total serum calcium. Ionized calcium concentration depends on albumin level and arterial blood pH value; it is therefore better to measure the ionized calcium concentration directly, by using ion-specific electrodes.

Preoperative preparation is focused on correcting hypercalcemia as a prerequisite of the occurrence of numerous disorders in almost all organs and systems. Calcium values over 3.5 mmol/l may result in hypercalcemic crisis which is a vitally endangering state.

Treatment of hypercalcemia

Hypercalcemia is treated by:
1. Hydration of patients
2. Stimulation of calcium excretion through kidneys
3. Simultaneous follow-up and correction of other electrolytic disorders
4. Inhibition of osteoclasts effect on bone resorption

Hydration of patients is effected by use of physiologic solution. Around 2000 ml (500ml/6h) are usually sufficient since patients are aged and with limited coronary reserve.

Stimulation of calcium excretion through kidneys is based on forcing diuresis by use of diuretics. The prerequisite of adequate hydration must be fulfilled, because diuretics are contraindicated in dehydrated (and hypotensive) patients. Henle loop diuretics (furosemide) are used - 80mg (II amp) infusion, every 6 hours. The dose can be cautiously increased, with adequate monitoring (hourly diuresis, hemodynamic parameters). Thiazide diuretics are contraindicated, because they "save" calcium - it is resorbed, not excreted!

Forcing of diuresis to eliminate calcium from the body by Henle loop diuretics results in a simultaneous excretion of other electrolytes (potassium, magnesium), with possible negative consequences; it is therefore necessary to follow and correct other electrolytic disorders (hypokalemia, hypomagnesemia). Use of KCl is recommended - 80mmol/24h, divided into 4 doses (KCl 20mmol, in addition to furosemide, to be added to each NaCl infusion). There are also other therapeutic measures aiming at reducing calcium level in plasma. These are introduced especially in patients with inadequate renal function where diuretics have no effect. One of these is a reduction of bone resorption. Bisphosphonates (pamidronate or zoledronic acid) given intravenously are the first choice for a majority of patients. Bisphosphonates act by inhibiting osteoclasts to cause bone resorption. Pamidronate initial dose: 60-90 mg by IV infusion during one hour. Zoledronic acid dose: 4 mg infused during 15 minutes. Effects duration is long - 32 days for zoledronic acid and 18 days for pamidronate. Effects appear with delay: decrease of calcium value is obtained 4-5 days after treatment was started, while the drug can be repeated if hypercalcemia reappears. Treatment is sometimes accompanied by fever and myalgia, in 10-20% of patients receiving bisphosphonates intravenously. Creatinine increase in serum requires dosage correction. Other bisphosphonates such as plicamycin or gallium nitrate were not used to a greater extent because of their toxicity.

In patients with pronounced hypercalcemia and renal insufficiency refractory to rehydration it is sometimes necessary to use an alternative, second line antiresorption agent such as calcitonin (dose: 4-8 iU/kg s.c. every 12 h). This can be useful, but most patients become totally refractory to this therapy within a few days.

Use of estrogens in menopausal women decreases bone resorption by decreasing osteoclastic activity. Their role is to stabilize BMD in those female patients where operation is impossible or unwanted. Estrogen receptor agonists were administered in PHPT, but their efficiency was limited. Although calcimimetic drugs are still considered experimental, one of these (cinacalcet hydrochloride) proved to be efficient in reducing PHT and normalizing calcium level in serum.

Organ function disorders as consequences of pHPT of importance for preoperative preparation

Besides hypercalcemia per se, it is also necessary to examine the consequences of hypercalcemia and pHPT on individual organs and systems. The following disorders have special importance for preoperative preparation, in particular from the anesthesiologic point of view:
1. Skeletal manifestations of hyperparathyroidism
2. Weakness of skeletal muscles, hypotonia and muscular mass loss
3. Anemia
4. Hypertension
5. Disorders of hydro-electrolytic and acid-base balances
6. Renal weakness
7. Gastrointestinal system’s disorders

These have a direct influence on the choice and dosage of drugs, especially anesthetics, used in the perioperative period, the possible difficult intubation, and the choice of anesthetization type and technique.

Skeletal manifestations of hyperparathyroidism - generalized osteopenia, subcortical bone resorption (on phalanges and clavicle distal ends), bone cysts, bone pain, pathologic fractures - are important for preoperative evaluation, because of repercussions that these disorders might provoke in the intraoperative period. Osteoporosis and tendency to pathologic fractures require very careful posi-
tioning of hyperparathyroidal patients on the operating table. This especially concerns the positioning of head and neck for endotracheal intubation. Extension must not be large and abrupt, to avoid fatal fracture of cervical vertebra. In order to prevent this complication it is necessary to order the patient (preanesthetic round) to throw back one’s head as much as possible and to carry out intubation extension, slowly and very carefully, only up to that limit defined by the patient himself. HPT patients in those surgical branches where difficult intubation is expected, such as thyroidal surgery, require special attention regarding intubation strategies and techniques.

Weakness of skeletal muscles, hypotonia and muscular mass loss, especially in lower limb proximal musculature, are frequent and can be so much pronounced that differential diagnosis should exclude multiple sclerosis and amyotrophic lateral sclerosis by muscle biopsy. Neuropathy, not myopathy, is at the bottom of these disorders. The cause of this neuropathy is unclear, it is even considered that it has no connection with hypercalcemia, but it is important that neuropathy is reversible and improves after surgery.

This neuromuscular system’s symptomatology has a very practical implication from the anesthesiologic point of view: the intraoperative need for muscle relaxants is reduced. On the other hand, it is logical to expect, in presence of hypercalcemia, that it antagonizes the effect of non-depolarizing muscle relaxants, that they degrade faster, that their effect is shorter and that major doses are necessary.

These two completely opposed viewpoints suggest a conclusion that muscle relaxants should be used very carefully. It is best to start with smaller initial doses and then monitor the neuromuscular block; use of peripheral nerve stimulator is desirable to that purpose. Concerning the choice of muscle relaxants, there is no recommendation which one would be best.

There are reports indicating increased sensitivity to succinylcholine chloride, but also resistance to atracurium. A persistently increased concentration of calcium in plasma can affect kidneys capacity to concentrate urine, which results in polyuria. Polyuria is also followed by polydipsia and renal calculi. Kidney weakness with oliguria may occur in disease’s developed stage. Parathormone increased values also result in an increased renal excretion of bicarbonates; chloride excretion is decreased. The result of this electrolytic imbalance (decreased bicarbonates and increased chlorides in plasma) is also an acid-base balance disorder in form of metabolic acidosis (mild to moderate).

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### TABLE 1

<table>
<thead>
<tr>
<th>Uremic toxic disorder</th>
<th>Significant characteristic of chronic renal failure for preoperative preparation and anesthesia</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hematological (anemia, pancytopenia)</td>
<td>Anemia</td>
</tr>
<tr>
<td>Dermatological (pruritus)</td>
<td>Coagulopathy</td>
</tr>
<tr>
<td>Electrolytes disbalance</td>
<td>↑K, ↑Mg, ↑P, ↓Ca</td>
</tr>
<tr>
<td>Metabolic and endocrine (insulin resistance, elevated blood level of glucagon, impotence, hypertriglicidemia)</td>
<td>Metabolic acidosis</td>
</tr>
<tr>
<td>Cardiovascular (hypertension, heart block, heart failure, decreased response for adrenalin, pericardial diseases)</td>
<td>Hypertension, Pericardial disease</td>
</tr>
<tr>
<td>Pulmonary (vascular calcifications, decreased pulmonary functions, increases susceptibility for infection)</td>
<td>Increased susceptibility for infection (pneumonia, sepsis). Slow wound healing</td>
</tr>
<tr>
<td>Neurological (disorders of CNS, PNS, ANS, impaired cognitive functions, alterses EEG)</td>
<td>Disorders of nervous system (encephalopathy, polineuropathy)</td>
</tr>
<tr>
<td>Musculoskeletal</td>
<td>Secondary hyperparathyroidism</td>
</tr>
<tr>
<td>Bone pain</td>
<td>Renal osteodystrophy</td>
</tr>
<tr>
<td>Fractures</td>
<td>Periarticular or tumor calcification</td>
</tr>
<tr>
<td>Skeletal deformities</td>
<td>Arthritis and pariarthritis</td>
</tr>
<tr>
<td>Growth depression</td>
<td>Visceral calcification</td>
</tr>
<tr>
<td>Arthritis, pariarthritis</td>
<td>Spontaneous tendon rupture</td>
</tr>
<tr>
<td>Tendon rupture, myopathy</td>
<td></td>
</tr>
</tbody>
</table>

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Br. 2 Preoperative preparation of patients with hyperparathyroidism as comorbidity
From the anesthesiologic point of view, a possible renal function disorder, even initial and mild, understands avoiding nephrotoxic agents. This regards, first of all, inhalation anesthetics the metabolism of which produces fluorid ions which are nephrotoxic, but also all other nephrotoxic drugs and agents (aminoglycosides, iodine contrast media et al.). Sevoflurane, actually one of the most preferred and used inhalation anesthetics, should rather be avoided because of fluoroides although its harmful effect in patients with initial renal insufficiency has not been proved in most clinical studies.

Maintenance of adequate hydration and urinary output within the intraoperative treatment of hypercalcemia is also of great importance. The best choice of infusion solutions for this purpose is 0.9% NaCl despite mild hyperchloremia which could exist in these patients; 5% glucose can also be used. Ringer lactate is not suggested because it contains calcium. It is recommended to follow hydration sufficiency through hourly diuresis and central venous pressure, excepting in very short operations.

Anemia occurs in all patients with hyperparathyroidism, not only those with renal insufficiency but also those without it; it is a direct consequence of primary hyperparathyroidism. It is necessary to provide enough blood for transfusion in operations where not only abundant but also moderate blood loss is expected, since anemic patients are particularly sensible to blood loss. Gas exchange in anemic patients is compromised, so that such intraoperative lung ventilation is required to be optimal for the patient. Theoretically, lung hyperventilation is undesirable because respiratory alkalosis (occurring during hyperventilation) reduces the level of potassium in serum and the effect of calcium remains nonantagonized. However, respiratory alkalosis can be useful since it reduces the level of calcium ionized fraction.

Systemic hypertension is the most frequent cardiovascular manifestation of HPT; ECG changes (increased P-R interval, reduced Q-T interval) occur, too. If hypercalcemia is extremely pronounced (over 3.5 mmol/l) conducton disorders may occur. Same as in other patients with hypertension as secondary disease, antihypertensives are taken regularly till the operation regardless the kind of intervention, and some (ex.: beta-blockers) even on the operation day. Intraoperative hypertensive crises or hemodynamic instability are possible, so that such patients sometimes require, besides standard monitoring (continuous ECG and pulse frequency measuring, frequent noninvasive arterial blood pressure measuring), also extended monitoring (CVP, hourly diuresis, continuous arterial blood pressure measuring). A continuous noninvasive arterial blood pressure measuring procedure (CNAP) became recently possible, which is a great advantage.

Gastrointestinal disorders related to pHPT could be vomiting, abdominal pain, peptic ulcerations, even pancreatitis. These manifestations could sometimes make it difficult to diagnose a gastrointestinal surgical disease; if they exist, all elective surgery, including subtotal hyperparathyroidectomy, must be postponed and disorders treated.

**PREOPERATIVE PREPARATION OF PATIENTS WITH SECONDARY HYPERPARATHYROIDISM**

Patients with secondary hyperparathyroidism (sHPT) are most frequently those with terminal chronic renal insufficiency (tCRF), on extrarenal depuration, so that surgery and anesthesia on them is difficult and risky. Patients with tCRF have uremic toxic disorders and damages repercursive on functions of almost all organs and systems (Table 1).

It is important, both anesthesiologically and surgically, to examine all afore mentioned uremic toxic disorders and characteristics of sHPT and CRF in order to have the patient adequately prepared, and correct anesthetic procedure and drug choice and dosage in the perioperative period applied.

Preoperative evaluation of tCRF and sHPT patients should be based on the following concepts:

1. Most important information: is the disease stable, worsening or improving; compulsory monitoring of creatinine level in plasma (quantification of glomerular filtration is not necessary)
2. Estimate liquid volume by measuring patient’s body mass before and after HD

<table>
<thead>
<tr>
<th>Mean of treatment</th>
<th>Dosage</th>
<th>Mechanism</th>
<th>Beginning of effect</th>
<th>Duration of treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calcium gluconate</td>
<td>10-20 ml i.v. in 10% solution</td>
<td>Direct antagonism</td>
<td>Quickly</td>
<td>15-30 min</td>
</tr>
<tr>
<td>NaHCO₃</td>
<td>50-100 mEq i.v.</td>
<td>Redirection to cell</td>
<td>15-30 min</td>
<td>3-6 hours</td>
</tr>
<tr>
<td>Glucose +insuline</td>
<td>25-50 gr i.v. with 10-20 i.u</td>
<td>Redirection to cell</td>
<td>15-30 min</td>
<td>3-6 hours</td>
</tr>
<tr>
<td>Hyperventilation</td>
<td>PaCO₂ 25-30 mmHg</td>
<td>Redirection to cell</td>
<td>Quickly</td>
<td>(10mmHg----&gt;0,5mEq/l)</td>
</tr>
<tr>
<td>Periton. dialysis</td>
<td></td>
<td>Clearance</td>
<td>1-3 h</td>
<td></td>
</tr>
<tr>
<td>Hemodialysis</td>
<td></td>
<td>Removing</td>
<td>Quickly</td>
<td></td>
</tr>
</tbody>
</table>

Table 2

<table>
<thead>
<tr>
<th>TREATMENT OF HYPERKALEMIA</th>
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<tr>
<td>Mean of treatment</td>
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<tr>
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</tbody>
</table>
Preoperative preparation of patients with hyperparathyroidism as comorbidity

Br. 2

Preoperative preparation of patients with SHPT

3. The last hemodialysis is optimal to occur 12 to 24 hours or at the latest 36 hours before operation, without heparin (to reduce the risk of uncontrolled intraoperative bleeding).

4. Preoperative check of vascular access for hemodialysis (arteriovenous fistulae) and its protection during surgery (when thrombosis might occur) are obligatory.

5. Examine the possibility, when patients reached an optimal status, to postpone the intervention planned, in order to proceed to previous surgical treatment of parathyroid glands hyperfunction (subtotal parathyroidectomy).

6. If surgical treatment of parathyroid glands is not possible, examine the possibility of reducing parathormone values by drugs, which is very important if kidney transplantation is planned.

All CRF characteristics and uremic toxic disorders, indicated in Table 1, should be taken into account. Preoperative preparation is to be focused especially on the following aspects:

Preoperative cardiologic evaluation is desirable since most SHPT and tCRF patients (around 80%) are hypertensive, and pericardial diseases are also frequent. If patients are on antihypertensive therapy, it is not suspended; if they are on cardiotonics, there is a possibility of digitalis intoxication. When these patients are anesthetized an important hypotension is possible, while hypertensive crises and acute disorders of cardiac rhythm are frequent during the operation and after it.

Electrolytic disorders are the most important aspect of preoperative preparation of SHPT and tCRF patients regardless of the type of surgical intervention (elective or urgent), because some of these represent life endangering states. Besides hypocalcemia (of long duration, being the cause of secondary HPT), CRF patients also have other electrolytic disorders related to impossibility of renal excretion: hyperphosphatemia (main cause of pruritus), hypermagnesemia and hyperkalemia. Consequences of hypermagnesemia are hypoventilation, CNS depression (of various extent, up to coma), hypotension, shock. The effect of all muscle relaxants is emphasized in anesthesia because of hypermagnesemia (because magnesium regulates presynaptic release of acetylcholine on nerve ends). Hyperkalemia is the most important electrolytic disorder from the anesthesiologic point of view. It may provoke various cardiac rhythm disorders (up to ventricular fibrillation and cardiac arrest). Continuous ECG monitoring is obligatory; ECG can show a high T wave, extended P-R interval and QRS complex. Elective surgery is to be postponed till potassium value is brought to 5.5 mEq/l. In urgent operations, immediate reduction of potassium level in plasma is necessary. (Table 2.)

The treatment of disease depends on the type of electrolytic disorders. Control of phosphatemia is aimed at maintaining phosphate concentration in plasma within 1.3 to 1.78 mmol/l limits which is achieved by dietetic measures (phosphates restrictive daily intake below 0.7g) and phosphate binders (the most used is calcium carbonate, but there are also newer, noncalcic binders). Special attention should be paid on avoiding hypophosphatemia; Al(OH)₃ as phosphate binder should also be avoided. Correction of hypocalcemia is effected, with regular monitoring of calcium and phosphate in serum, under obligatory condition that correction of hyperphosphatemia has been previously (and simultaneously) achieved. Potassium removal is effected by regular hemodialyses.

In cases of urgent surgical interventions, correction of hyperkalemia is possible to be effected by potassium diversion into cells or by use of antagonists. It is of special importance in correcting hyperkalemia to know when therapy will start working and for how long will it work, that is, does it provide safety in the perioperative period (Table 2). Patients with preserved diuresis can receive Henle loop diuretics or thiazide diuretics which support potassium excretion.

Preoperative preparation of anemic SHPT patients differs from that of anemic pHPT patients. While anemia in pHPT ones must be corrected preoperatively by transfusions (till hematocrit value exceeds 30%), correction of anemia by transfusions in SHPT ones is effected only with respect to their so-called "stable state". These patients are well adapted to chronic (moderate) anemia, so that correction is effected not to reach normal hemoglobin and hematocrit values but those (moderately lower) values to which the patient is adapted.

Nervous system's disorders can be manifested as various forms of encephalopathy, with resulting cognitive deficit possible to increase postoperatively. Polyneuropathies of different peripheral nerves (usually median and peroneal) must be examined, especially in context of regional anesthesia (some peripheral nerve blocks, for example in orthopedic surgery). Changes also occur in the autonomous nervous system resulting in a reduced compensatory response of the body to volume changes. Unexpected increased sensitivity to anesthetics, opioids and other drugs used intraperatively may occur as a consequence of these changes in the nervous system. The immediate postoperative period can be followed by some complicati-
ons such as longer wakening from anesthesia, confusion, agitation.

Diabetes mellitus is frequently associated with CRF, so that it is necessary to measure glycemic values more frequently, or even give insulin if necessary. Viral hepatitis is frequent (because of frequent use of blood products); adequate protection of physicians and medical staff participating to surgical treatment of these patients is therefore necessary.

Gastric discharge is retarded in CRF patients (passive regurgitation and aspiration of gastric content into lungs while proceeding to tracheal intubation are possible). Laryngoscopy and intubation may be difficult both in pHPT and sHPT patients because of multiple deformities of bones and joints; this is more frequent in sHPT patients where deformities are more pronounced (Figure 1). Their careful positioning on the operating table is required (same as in the case of pHPT patients), since bone fractures are possible because of extreme osteopenia, osteoporosis and fragility of bones and joints.

Unexpected and uncontrolled intraoperative and postoperative bleeding is possible to occur, unrelated to surgical hemostasis, because of deficiency of von Willebrand factor as prerequisite of coagulopathies and nonsurgical bleeding. One is to suppose and foresee unexpected bleeding in these patients even when laboratory parameters do not show deviations (from normal values of PT, PTT, INR, number of thrombocytes, etc.), and prepare fresh frozen plasma and blood for all operations, even those smaller.

These patients incline to infections and prolonged healing of wounds. Profilactic use of cephalosporin antibiotics (one hour before operation or at the latest immediately on anesthetization) is therefore recommended for all surgical interventions, even those smaller.

During preoperative preparation and deciding all surgical treatment stages it is also necessary to examine a possible occurrence of problems and complications within the immediate postoperative period, especially within the first postoperative hour, and therefore carefully monitor the patient (especially by anesthesiologist). Problems and complications possible to occur are:

1. Prolonged muscle relaxation
2. Prolonged respiratory depression and hypoventilation
3. Hypoxia (because of hypoventilation and anemia)
4. Hypertension
5. Arrhythmias (because of hyperkalemia)
6. Important hyperkalemia requiring urgent hemodialysis
7. Prolonged CNS depression (because of the use of opioids)
8. Unpredictable reaction to anesthetics and other drugs (confusion, agitation)

Round-the-clock postoperative monitoring of cardiovascular, respiratory and laboratory parameters is obligatory for these reasons. Postoperative stay in intensive care units should be planned for sHPT patients even after smaller surgical interventions.

CONCLUSION

Preoperative preparation of patients with hyperparathyroidism as comorbidity requires, in all surgical branches, the knowledge of parathyroid glands hyperfunction effects and of their repercussions to vital organs and systems. It is desirable to consult endocrinologists in this preparation but, since endocrinologists are not always available (urgent surgical interventions, smaller provincial hospitals, etc.), it is obligatory that surgeons and anesthesiologists possess all necessary knowledge in this hormone’s pathophysiology. The team that directly participates in surgical treatment makes most decisions concerning preoperative preparation even in presence of a competent endocrinologist, because endocrinologists are not familiar with surgical and anesthesiologic techniques, perioperative procedures, anesthetics and other drugs used intraoperatively (interfering directly or indirectly with hyperparathyroidism).

In elective surgical interventions on patients whose various organs present evident disorders because of the consequences of hyperparathyroidism it is necessary to postpone surgery till these disorders are eliminated. It is also suggested, when patient’s status is stabilized, to proceed first to subtotal parathyroidectomy to solve permanently the consequences of HPT, and only then to surgical intervention planned. Preoperative preparation of patients with HPT as comorbidity for urgent surgery is limited only to vitally endangering consequences of HPT, because of lack of time.

SUMMARY

PREOPERATIVNA PŘIPREMA BOLESNIKA SA HIPER-
PARATIREOIDIZMOM KAO KOMORBIDITETOM

Preoperativna priprema bolesnika sa hiperparatiroidizmom, kod kojih je planirano i/ili sprovedeno hirurško lečenje zbog nekog drugog oboljenja, odlikuje se specifičnostima u zavisnosti od toga da li se radi o primarnom ili sekundarnom hiperparatiroidizmom. Kada je u pitanju primarni hiperparatiroidizam, od najvećeg značaja su reperkusije izražene hiperkalcemije na pojedine organske i organske sisteme. U tom smislu, najvažniji aspekt preoperativne pripreme ovih bolesnika je lečenje hiperkalcemije.

Kod bolesnika sa sekundarnim hiperparatiroidizmom kao komorbiditetom, nivo kalcijuma je od manjeg značaja budući da je on, uglavnom, u granicama referentnih vrednosti. Od najvećeg značaja za preoperativnu pripremu je činjenica da su u pitanju bolesnici sa hroničnom bubrežnom insuficijencijom, koji su najčešće na ekstrarenalnoj depuraciji, pa se kod ovih bolesnika moraju uzeti u obzir uremijski toksični poremećaji od značaja za peroperativni tok.

Poremećaji uzrokovani primarnim ili sekundarnim hiperparatiroidizmom (i terminalnom hroničnom bubrežnom insuficijencijom) moraju se dovesti u tzv. "stabilno stanje" kod elektivnih hirurških intervencija. Kada su u pitanju hitne hirurške intervencije, tada je preoperativna
priprema usmerena samo ka vitalno-ugrožavajućim posledicama hiperparatireoidizma, kao što je hiperkalcemija, kriza ili ekstrema hiperkalemija.

Ključne reči: primarni hiperparatireoidizam, sekundarni hiperparatireoidizam, preoperativna priprema, hirurško lećenje, anestezija

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