

Thyroid Dysfunction: A Bit Problem in Perioperative Management

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KEYWORDS

thyroid
dysfunction,
hypothyroidism,
hyperthyroidism,
perioperative
management,
endocrinology

ABSTRACT:

Thyroid dysfunction was a thyroid abnormality causing hyperthyroid or hypothyroid. It predisposed complications during surgery and the recovery. In uncontrolled thyroid dysfunction patients, surgery could cause severe cardiorespiratory depression, even death. These complications could happen unexpectedly. Even though thyroid function examinations prior surgery wasn't recommended, they should be done for optimizing perioperative condition in thyroid dysfunction patients. Euthyroid condition should be achieved prior elective surgery. Whereas proper prevention should be done prior urgent or emergency surgery. This review aimed to explain perioperative management on thyroid dysfunction and to recommend the treatment approach. It also aimed to decrease surgical complication risk due to thyroid dysfunction in order to give understanding for clinicians.

1. Introduction

At this moment, thyroid dysfunction was a common disease. Goiter incidence was 15-30% in endemic area from adult population (1). Hyperthyroid prevalence in the world was 0.2-1.3%. United States National Health and Nutrition Examination Survey (US NHANES III) in 2002 stated hyperthyroid was detected on 0.5% population, subclinical hyperthyroid on 0.7% population and the overall prevalence was 1.3%. Whereas hypothyroid was affected by iodine deficiency. Hypothyroid prevalence in iodine adequate country was 1-2%. Hypothyroid was ten-fold more common in woman (2).

Thyroid hormone played an important role in heart contractility, vascular tonus, water and electrolyte imbalance and central nerve system. Stress during surgery in hypothyroid had direct effect on thyroid axis, in thyrotropin (TSH) and triiodothyronine (T3) level (3). Uncontrolled myxedema in hypothyroid was an emergency condition and one of the perioperative risks. Undiagnosed or uncontrolled hypothyroid-related perioperative morbidity incident was unknown, but the major complication was severe cardiorespiratory depression (4).

Thyroid crisis often occurred on secondary thyrotoxicosis patients. This condition was happened in Grave disease whether on therapy, newly diagnosed or the uncontrolled one. Surgery was one of the precipitating factors for thyroid crisis. Its mortality was 30% though the condition was known prior and got earlier treatment (5). This review would discuss perioperative management on thyroid

dysfunction, whether hypothyroid or hyperthyroid. Hopefully this review would help clinician to manage thyroid dysfunction on elective or urgent surgery and prevent its complications.

2. Preoperative Screening

Routine thyroid disease examination was not recommended in patients without thyroid dysfunction history. As clinician should look for thyroid dysfunction signs and symptoms to avoid surgery complication (6,7). TSH was recommended on patients with suspiciousness of thyroid disease. Thyroid dysfunction patients who underwent surgery should do an assessment to determine and to ensure they were on adequate therapy and optimal condition. History taking and physical examination were done to look for cardiopulmonary comorbidity and other endocrinology disorders. Laboratory examination such as thyroid function, complete blood count and basic metabolic was taken prior surgery. If the surgery could be postponed until euthyroid was achieved then the patient could do elective surgery. And if the surgery couldn't be postponed then the patient should be done an urgent or an emergency surgery (8,9).

3. Hypothyroid

Hypothyroid definition was a decrease of thyroid hormone synthesis and secretion. This hormone was referred to thyroxine (T4) and T3. Undiagnosed hypothyroid prevalence was 0.6-1.2% in woman and 1.3-4.0% in man. The highest subject was elderly. Subclinical hypothyroid prevalence in China was 16.7%, reflected a transition to iodine sufficiency. Whereas in India, hypothyroid prevalence was 10%. The coastal city in India had lower prevalence, that is 11.73% (2,10,11).

Research in Mayo Clinic Rochester stated hypothyroid had one of the risk factors for complication in surgery. These risk factors such as anemia and hypertension. Mechanical problem for intubation was caused by obstructive goiter. Inferior cava vein was obstructed by retrosternal goiter thus caused a vocal cord dysfunction. This condition made intubation procedure became more difficult (9). Hypothyroid caused myocardium function depression, spontaneous ventilation depression, abnormal baroreceptor function, plasma volume decrease, anemia, hypoglycemia, hyponatremia and drug metabolism disruption in liver (1).

Hypothyroid was classified into three categories, that was mild hypothyroid, moderate hypothyroid and severe hypothyroid. Mild hypothyroid was a subclinical hypothyroid condition. There was an increased in TSH level while free T4 (FT4) level was normal. Moderate hypothyroid was an increased T4 level and mild decrease in TSH level. Severe hypothyroid was myxedema coma condition. It had severe symptoms or there were severe complications, such as altered mental status, pericardium effusion, heart failure or T4 level < 0.5 ng/ dL (2,8,12). There were four factors associated with poor surgical outcome. Those were 1) moderate or severe hypothyroid; 2) preoperative FT4 level ≤ 1 μ g/ dL; 3) preoperative TSH level > 20 μ U/ mL; 4) hypothyroid duration > 13 months (13).

TSH and T3 level alterations was a direct effect to thyroid axis caused by stress due to surgery. Hypothyroid patients who underwent surgery would have euthyroid sick syndrome classic manifestation. Increased cortisol serum was also induced by surgery causing thyroid axis alteration (2). There hasn't been any randomized controlled trial evaluating euthyroid and hypothyroid surgery outcome yet (9). Complication often occurred on severe hypothyroid. Myxedema coma and alteration of cardiac or respiratory were perioperative complication. Whereas postoperative complication was ileus, neuropsychiatric complication, coagulopathy and wound healing alteration, difficult to get off from ventilator and heart failure. Myxedema itself was rarely occurred and its mortality rate was 80% (12,14).

One of abdominal surgery complication was decreased in gastrointestinal motility or ileus. Chronic constipation also could be caused by hypothyroid. Hypogastrinemia often occurred on hypothyroid likewise hypergastrinemia on hyperthyroid. Bowel response to secretory hormone such as vasoactive intestinal polypeptide was also affected by thyroid hormone. Malabsorption and bowel motility was worsened. these conditions were especially happened after bowel resection and were caused by hypothyroid condition (3).

Most of hypothyroid patients got thyroid hormone replacement therapy and became euthyroid at time of surgery, especially on elective surgery. Research in South Korea reported subclinical hypothyroid associated with increased in post operative atrium fibrillation incidence on coronary artery bypass grafting surgery. Another research stated there was no difference on successful surgery procedure, hospital discharge, hospital cost and hospital mortality. Surgery on hypothyroid should be postponed until euthyroid was achieved. Research in Boston stated hypothyroid tend to had intraoperative hypotension in non-cardiac surgery. Whereas on cardiac surgery, they tend to had perioperative heart failure (9,15).

4. Recommendation for Hypothyroid

When euthyroid was achieved in hypothyroid patients, there was no increased in morbidity risk and didn't need a special therapy other than continued the old treatment (15). There was a situation when hypothyroid patients who needed surgery on certain condition or preparing for endoscopic procedure that needed fasting, might not get levothyroxine (LT4) orally in a few days. If fasting was done more than five days, LT4 would be given intravenously. The given dose was 75% from their oral dose (16). Whereas patient with hypothyroid, the TSH level was higher than normal and FT4 level was below normal, elective surgery should be postponed until euthyroid was achieved (9).

Journal published on 1997 stated there was controversy on mild or subclinical hypothyroid patients. At that time, there wasn't any well design research proven that postponed surgery due to thyroid hormone replacement improve perioperative outcome (15). Tang and Hennessey stated it was safe to undergo urgent operation on subclinical hypothyroid. Due to lack of clinical evidences that stated subclinical hypothyroid had significant negative effect on surgery outcome, clinician should consider another comorbidity and anticipated minor surgery complication probability (9).

In severe hypothyroid, marked by myxedema coma, altered mental status, heart failure or low thyroid hormone level, surgery should be postponed until patient was well treated. If urgent surgery should be done and couldn't be postponed, thyroid hormone replacement was administered immediately. Drug of choice was intravenous LT4 loading dose 200 microgram followed by maintenance dose 75% from oral dose, that is 1.6 microgram/kg/day on patient < 60 years old without cardiovascular comorbidity or 12.5 – 75 microgram per day on patient > 60 years old or had cardiovascular disease. Adrenal insufficiency examination should be done. Adrenal insufficiency was often happened coincidence with myxedematous patient or on patient with unstable hemodynamic. Adrenal insufficiency was happened due to thyroiditis Hashimoto, often in primary hypothyroidism patients. Intravenous stress dose corticosteroid should be administered prior LT4 administration to prevent adrenal crisis precipitation. If adrenal status hasn't yet been known, it was better to do cosyntropin stimulation test. The given regimen of corticosteroid was hydrocortisone 50–100 mg every 6–8 hours. After clinical improvement was happened, intravenous LT4 could be replaced orally. Exception to thyroid hormone replacement therapy was only on patient who need urgent cardiac revascularization (7,9,12,14).

5. Hyperthyroid

Hyperthyroid was defined as syndrome associated with thyroid hormone excess production. It was marked with decreased in TSH and increased in T4. Hyperthyroid prevalence was 0.2 to 1.3% in adequate iodine area. In the US at 2002, hyperthyroid was detected on 0.5% general population, whereas 0.7% were subclinical hyperthyroid and the total prevalence was 1.3% (2,17). According to Indonesian Health Basic Research in 2013, 0.4% Indonesian population, that is 700,000 people, was diagnosed with hyperthyroid. About 0.6% of hyperthyroid patients was female (18). Hyperthyroid classic feature was weight loss, tremor, heat intolerance and hyperactivity. Surgery on uncontrolled hyperthyroid patients was associated with 20% of mortality rate. This was caused by thyroid crisis (9).

Prominent hyperthyroid manifestation was cardiovascular manifestation. This manifestation was positive inotropic and chronotropic effect of thyroid hormone on the heart, vasodilation that caused decrease in systemic vascular resistance and increased in sodium and water retention mediated by renin-angiotensin-aldosterone system. Atrial fibrillation as its complication was occurred in 10-15% patients (8). Hypertension crisis was often occurred. This situation especially occurred in major and emergency surgery. Besides, sedation or anesthesia drugs administration also gave adrenergic stimulation effect (14).

6. Recommendation for Hyperthyroid

In subclinical hyperthyroid, when the TSH level was decreased but the T3 and T4 levels were normal, elective surgery could be done after beta blocker initiation if there was no contradiction (9). Prospective random research showed hyperthyroid who had thyroidectomy and treated with 5 weeks metoprolol prior surgery, didn't have intra or post operative complication. Beta blocker should be administered for few weeks as surgery preparation. This administration was continued during postoperative period to prevent thyroid crisis. Propranolol was preferred by clinician as drug of choice. This was caused by its T4 reduction effect, that was using T4 to T3 conversion mechanism. But β -1 selective blocker such as atenolol or metoprolol gave action duration effect longer and had better safety on obstructive lung disease. This administration target was the pulses less than 80 beats per minute (8,9).

In hyperthyroid condition, elective surgery should be postponed until euthyroid was achieved due to thyroid crisis precipitation risk. Treatment for hyperthyroid was continued during perioperative. Beta blocker should be administered seven days prior noncardiac surgery. Atrial fibrillation often occurred on hyperthyroid and its prevalence was more often in elderly (9,12).

Hyperthyroid patients who underwent urgent or emergency surgery needed a strict perioperative monitor. This monitoring was done to decreased the mortality risk. The aim of this monitoring was to ensure there was no cardiovascular complications due to sympathetic activity (19). Beta blocker administration should be given immediately and calcium channel blocker could be a choice if there was beta blocker administration contraindication. Beta blocker which often used was propranolol, had additional benefit as inhibited the active thyroid hormone conversion. Propranolol dose was started at 40–80 mg orally every 4–8 hours and titrated until the target was achieved. The target was pulses less than 80 beats per minute. Beta blocker was continued during postoperative on non-thyroid surgery, at low dose, thought patient still had thyrotoxic as clinical featured (9,12).

Antithyroid drugs, especially thionamide (methimazole and propylthiouracil/ PTU) had effect of decreasing thyroid hormone synthesis. These drugs were administered orally or rectally. These drugs should be administered immediately on non-thyroid surgery if the hyperthyroid etiology was Grave disease or toxic nodular goiter (9,12). PTU initial dose was 100–150 mg every 6–8 hours orally. According to 2016 American Thyroid Association (ATA) guideline, if there was thyroid crisis, PTU

was administered 500–1000 mg as loading dose and followed by 250 mg every 4 hours as maintenance dose (20).

Antithyroid drugs took time 3–8 weeks to achieve euthyroid level. If the patient needed surgery immediately, iodine was added to decrease new thyroid hormone production. Iodine was administered one hour after thionamide administration. Iodine could be administered on five drops of iodide potassium saturated solution (50 mg iodine each drop) every 6 hours orally. Iodine administration should be discontinued after surgery (9,12).

Stress dose glucocorticoid was administered to overcome low adrenal backup and prevent T4 to T3 conversion mechanism. The standard regimen was hydrocortisone 100 mg every 8 hours intravenously on the day of surgery and tapered down for three days. Another regiment was dexamethasone 2 mg every 6 hours or betamethasone 0.5 mg every 6 hours intravenously (9,12).

Cholestyramine, a bile acid sequestrant, was additional modality that could be used to decrease thyroid hormone fast. The administration dose was 4 g every 6 hours. Cholestyramine lowered circulating thyroid hormone level by binding them in bowel and decreased their reabsorption as lowering their level in enterohepatic circulation. Cholestyramine administration was discontinued after surgery (8,9).

7. Recommendation for C-Section

The complications of hypothyroid in pregnancy were hypertension in pregnancy, placental abruption, spontaneous abortus, preterm labor, low baby weight, fetal distress and perinatal mortality. Research in 2006 stated adequate hypothyroid therapy during pregnancy could minimize preterm labor risk without increasing its complication risk (21). The most severe hypothyroid complication was myxedema coma. Its mortality was 80%. This complication triggered by surgery and sedative drugs administration. Perioperative hypothermia prevention decreased surgery wound infection risk, myocardial ischemia and perioperative coagulopathy. During and post-surgery, hypothermia preventions were done by warm infusion and heating mat (22).

Hypothyroid manifestations were hypoglycemia and hyponatremia. Coagulation factor became consideration to do anesthesia in c-section patients. Hypothyroid caused anemia, platelet dysfunction, decrease in factor VIII, prolonged partial thromboplastin time and Von Willebrand disease. Hereby regional anesthesia became a choice if there were no prolonged hemostatic function. Case report in 2019 stated levothyroxine should be given prior surgery on elective one. Whereas in urgent or emergency surgery, levothyroxine was given intravenously. Its loading dose was 200–500 microgram per day, continued with 50–100 microgram per day (23).

Case report in 2016 stated c-section was one of thyroid crisis precipitation factor. They reported thyroid crisis that happened after c-section on hyperthyroid patient. This case was in accordance with another case report in 2019. They stated thyroid crisis often happened after surgery though the patient was on euthyroid condition (23,24).

Besides, uncontrolled hyperthyroid state was associated with increased of neonatal and maternal morbidity and mortality. Case report written by Park, et al. stated general anesthesia was often chosen in urgent surgery. This was chosen due to this anesthesia provide an adequate sedation and had minimal hemodynamic parameter fluctuation. This anesthesia would make an irritation due to endotracheal tube during induction. This would stimulate sympathetic nerve so that pulse and blood pressure were increased. Furthermore, surgery manipulation also stimulated sympathetic nerve. Neuraxial anesthesia could be used as alternative due to pulse and blood pressure decreasing via sympathetic blockade, decreased side effect due to histamine and provide adequate post-operation pain control (25).

8. Conclusion

Thyroid dysfunction should be noticed in surgery and made severe complication if not known immediately. Treatment goals in perioperative patient with thyroid dysfunction were to achieve normal thyroid hormone level before surgery intervention. Multidiscipline approach between surgeon, anesthesiologist and endocrinologist was important to prevent complications in thyroid dysfunction patients. This approach especially was done in patient needed emergency or urgent surgery. The conditions that needed attention were airway management and hemodynamic monitoring. Future systematic review or meta-analysis would be required for supplying this review.

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