

Educating Student Registered Nurse Anesthetists (SRNAs) on diagnosing and managing perioperative thyroid storm using a simulation scenario

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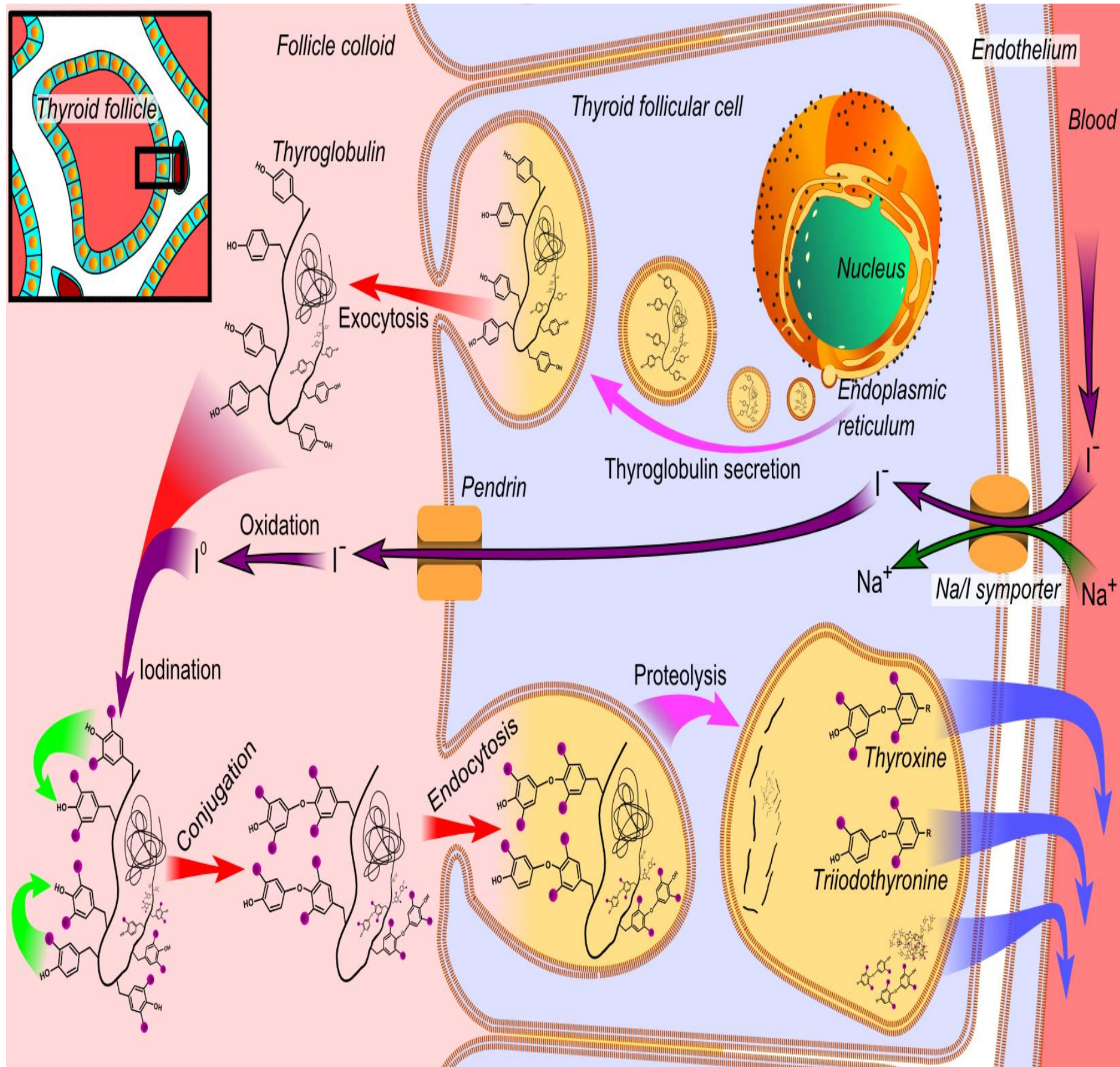
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Description

- Thyroid storm is one of the most highly ranked endocrine emergencies and is an extreme presentation of thyrotoxicosis. Although intraoperative thyroid storm incidence is a rare event in hyperthyroid patients (10%), it accounts for high mortality rate of up to 75% due to cardiac failure, shock, thromboembolic complications, and multiorgan failure. Timely recognition and the management of TS is vital for the anesthesia provider in ensuring patient safety and prevention of fatal outcomes.

Due to similar presentation, TS can easily be confused with MH. The following chart provides differential diagnostic criteria:



THYROID STORM	Malignant hyperthermia
Tachycardia	Tachycardia
Unstable blood pressure (initially high, then low)	Unstable blood pressure (initially high, then low)
Profuse sweating	Profuse sweating
Hyperthermia	Hyperthermia
Severe dehydration	Severe dehydration
Metabolic acidosis due to overproduction of lactic acid	SEVERE metabolic acidosis due to overproduction of lactic acid
CNS changes (psychosis, agitation, seizure, coma)	Respiratory acidosis
Hypokalemia (U wave on ECG)	Hyperkalemia due to acidosis (tall T wave on ECG)
Normal ETCO ₂	Elevated ETCO ₂
Elevated T3 and T4 levels (not readily available)	Generalized muscle rigidity, including masseter muscles
Pulmonary edema	Elevated creatinine phosphokinase levels
	Cyanosis due to arterial hypoxemia

Literature Review

- Literature review was performed on Ovid Medline, EBSCO, Google Scholar, and ProQuest databases with the following key words: "educating SRNAs on intraoperative thyroid storm", "intraoperative thyroid storm". The literature review did not reveal any research on educating SRNAs, but yielded several case studies and pathological review of thyroid storm.

Thyroid storm

- is a hyper-metabolic event which can lead to severe hypertension, which when left untreated can progress to arrhythmias, heart failure, hypotension, and eventually cardiovascular shock;
- Thyrotoxicosis is mainly caused by the Grave's disease (60-80%) and to lesser degree by toxic multinodular goiter and solitary toxic adenoma. Stressors like surgery, trauma, diabetic ketoacidosis, myocardial infarction, pulmonary thromboembolism, alcohol intoxication, parturition, and infection account for the exacerbation of symptoms (Table 3). Administration of iodine based medications like intravenous iodine contrast and amiodarone infusions can also trigger iatrogenic thyroid storm. Salicylates, steroids, furosemide, heparin, diazepam, phenytoin, non-steroidal anti-inflammatory drugs (NSAIDs), and carbamazepine have also been reported to precipitate TS by increasing free T3 hormone levels in serum by competing for binding sites on albumin.

Neuroleptic malignant syndrome might present with similar signs and symptoms as TS (fever, tachycardia, abnormal BP, tachypnea, diaphoresis). Major differential diagnosis involves lack of exposure to antipsychotic medications in TS.

Nurse Anesthesia Implications

- Treatment should be focused on four domains: treating underlying disease, preventing secretion and release of thyroid hormone thus preventing systemic effects of the hormone, and supportive care. Most authors recommend administering thionamides (propylthiouracil, methimazole) 30-60 minutes before loading with iodine in order to inhibit stimulation of new thyroid hormone synthesis. Thionamides inhibit thyroperoxidase, which catalyzes T3 and T4 formation; PTU also blocks conversion of T4 to T3 in the target cells. Subsequent iodine therapy prevents release of the stored thyroid hormone and iodine transport.
- Patients with hyperthyroidism usually have up-regulation of beta-adrenergic receptors. Therefore, beta blockers should be administered to offset cardiovascular effects. Traditionally, propranolol has been administered parenterally; esmolol or metoprolol can be used in the patients with the irritable airway disease. In high doses, propranolol also blocks conversion of T4 into T3 in the target cells, thus lowering serum levels of an active hormone. Glucocorticoids like hydrocortisone and dexamethasone are also known to block T4 to T3 conversion, and may be given to treat possible adrenal insufficiency due to high catabolism of endogenous glucocorticoids.

Drug	Typical adult dose	Action
Antithyroid agents		
propylthiouracil (also called PTU)	1,200 – 1,500 mg/day, given in 200 – 250 mg increments PO or via gastric tube	Prevents production of more T ₄ and T ₃ in the thyroid, and blocks the conversion of T ₄ to T ₃ outside the thyroid.
methimazole (Tapazole)	120 mg given in 20 mg increments PO or via gastric tube	Prevents production of more thyroid hormone.
Iodides		
Lugol's solution	10 drops twice a day PO or via gastric tube	Blocks release of stored thyroid hormone from thyroid gland.
saturated solution of potassium iodide (Pima, SSKI)	8 drops every 6 hours PO or via gastric tube	
Glucocorticoids		
dexamethasone (Decadron)	2 mg every 6 hours, PO or IV	Blocks conversion of T ₄ to T ₃
hydrocortisone	100 mg IV every 8 hours	
Beta-blockers		
propranolol (Inderal)	1 mg/min IV as required, then 60 – 80 mg every 4 hours PO or via gastric tube	Reduces symptoms (tachycardia, tremor, restlessness) caused by a heightened response to catecholamines; blocks conversion of T ₄ to T ₃ .
esmolol (Brevibloc Injection)	500 mcg/kg/min for 1 minute, then 50 – 100 mcg/kg/min for 4 minutes	

Results and Outcomes

- A pre and post-test consisting of 15 questions was administered to the junior anesthesia student in respect to the PowerPoint presentation.
- •Average scores on the pre-test was 4.65 correct responses with a high of 7 and a low of 3 making an average score of 31%.
- •Average scores on the post-test was 9.61 correct responses with a high of 12 and a low of 3 making an average score of 64.1%
- •The PowerPoint presentation resulted in an average of 5 more correct responses and a 106.45% total increase in percentage.
- •It can be concluded that the PowerPoint presentation was successful in enhancing the knowledge of the junior anesthesia student and possibly equipped them with the tools necessary to prevent, identify and manage

Conclusions

- After implementation of all set goals we can conclude that the project was successful and the information presented to the junior class was well understood. The objectives presented were met and the presentation built on the existing knowledge will be lasting and valuable to the junior class.

References

- Available upon request

• Acknowledgements

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