

# Hyperthyroidism associated with an increased risk for infection: A case report

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## ABSTRACT

**Introduction:** Infection risk associated with hyperthyroidism although not uncommon, may present with increased mortality if left untreated. The role of hyperthyroidism and its risk for infection is primarily due to the hypermetabolic effect on the body. Modification to the sympathetic nervous system produces a downregulation of the neutrophil response towards the sites of inflammation and/or infection. Consequently, remarkably increasing the risk for complications of infections to occur i.e., bacterial pneumonia. **Case Report:** A 34-year-old Caucasian female presented to the emergency room complaining of tachycardia, isolated systolic hypertension, tremors, dyspnea, fever, chills, and productive cough with yellow-brown sputum for five days. She reported several similar episodes have occurred in the past. A clinical diagnosis of hyperthyroidism with thyroid storm induced pneumonia was made by the physician and the patient was admitted to the ICU for treatment and close monitoring. Urinary antigen testing detected a positive result for *Streptococcus pneumoniae* or pneumococcal pneumonia to confirm the pneumonia and treatment was initiated. **Conclusion:** The role

of hyperthyroidism and its risk for infection causes devastating infectious complications, such as pneumonia, an example that this patient experienced along with having similar episodes in the past but without causality to account for why they are recurrent. Clinical suspicion for diagnosing hyperthyroidism will vastly aid in the management of patient's more effectively and hopefully avoid any infectious complication that may result. It is entirely important that these patients should be closely monitored to help prevent any further complications that may present upon admission.

**Keywords:** Hyperthyroidism, Infection, Pneumonia, Thyroid storm

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## INTRODUCTION

Hyperthyroidism can be defined as an overactive thyroid, a condition in which your thyroid gland produces too much of the hormone thyroxine (T<sub>4</sub>). An overactive thyroid increases the basal metabolic rate and increased sympathetic nervous system activity in the human body. Changes in the sympathetic nervous

system cause a downstream of effects, an example being a rare complication of thyroid storm with increased infection risk. It manifests itself as a state of exaggerated hyperthyroidism accompanied by systemic organ decompensation. The etiology of thyroid storm can range from poorly controlled to precipitant such as infection, surgery, diabetic ketoacidosis, etc. Increased infection risk is a serious complication these patients face because they are at a higher risk than the normal average person due to the lapse of neutrophil attraction towards sites of inflammation and/or infection. This occurs because hyperthyroidism causes a hypermetabolic effect causing a downregulation of neutrophil response to sites of infection, resulting in complications such as bacterial pneumonia.

## CASE REPORT

A 34-year-old Caucasian female presented to the emergency room complaining of tachycardia, isolated systolic hypertension (148/82), tremors, dyspnea (respiratory rate 28), fever (102.4), chills, and productive cough with yellow-brown sputum for five days. She reported several similar episodes have occurred in the past. Also, the patient stated that she had persistent symptoms of anxiety and myalgia as well, especially for the past two weeks. Nothing alleviated or persisted the patient's symptoms. She denied any medication use, recent travel, contact with those whom are sick, rhinorrhea, nausea, rash, urinary/bowel changes, sleep disturbance, recent infection, and dizziness. Physical examination revealed bilateral expiratory wheezing along with a normal S1/S2, no murmur, rub, and gallop present on arrival.

Chest radiograph and echocardiogram were ordered initially. The results revealed left lower lobe opacification with pleural effusions consistent of a lobar pneumonia and revealed a mild systolic ejection murmur, respectively.

A clinical diagnosis of hyperthyroidism with thyroid storm induced pneumonia was made and the patient was admitted to the ICU for treatment and close monitoring.

Treatment regimen consisted of:

- Rocephin 1 g IM once every 24 hours
- Zithromax 500 mg by mouth once then 250 mg by mouth once a day for four days.
- Tamiflu 75 mg by mouth once a day for 10 days (ICU prophylaxis due to another patient whom acquired H1N1 influenza)
- Methimazole 15 mg by mouth three times a day
- Propranolol 5 mg IV
- Atrovent HFA 2 puffs by mouth every six hours or as needed.
- IV steroids 125 mg IV for three days

Day 1 to day 3 of hospitalization, following the results of radiology and the echocardiogram, the patient experienced a change in consciousness and was placed

on mechanical ventilation due to high risk of aspiration potentially worsening the pneumonia. Additional tests were ordered to confirm the physician's clinical diagnostic suspicion: complete blood count (CBC) with differential, comprehensive metabolic panel, thyroid functioning tests, sputum gram stain, urinalysis, and blood cultures.

Result findings proved to have a decreased TSH ( $<0.07 \mu\text{U/mL}$ ; normal:  $0.5\text{--}5.0 \mu\text{U/mL}$ ) and an increased T3;  $490 \text{ ng/dL}$  (normal range:  $115\text{--}190 \text{ ng/dL}$ ) and free T4 level  $33.5 \mu\text{g/dL}$  (normal range:  $5\text{--}12 \mu\text{g/dL}$ ). It is also noted that within the CBC differential, the absolute neutrophil count was 1.13 (ANC normal range:  $1.5\text{--}8.0$  or  $1,500\text{--}8,000/\text{mm}^3$ ).

Sputum gram stain was inconclusive due to lack of specimen gathered from patient. Urinary antigen testing detected a positive for *Streptococcus pneumoniae* and treatment remained the same but route of administration changed from by mouth to either IV or IM.

Day-2 of hospitalization, the patient's vitals were unstable exhibiting hyperpyrexia (101.6) but blood pressure was managed within normal limits. The patient was closely monitored and remained on mechanical ventilation as she was in and out of consciousness. Medication regimen remained the same.

On day-3 the patient's body temperature fell slightly above normal limits. Blood pressure was still controlled and was within normal limits. Mechanical ventilation was still in place but ordered for extubation the following day pending patient stability and new radiographs and labs were to be drawn.

On day-4 patient's vitals were within normal limits and new radiographs and labs were taken. Extubation was unremarkable. Physical examination revealed decreased bilateral expiratory wheezing. Result findings of chest radiographs proved to show diminished right lower lobe opacification and no pleural effusions present. Laboratory results improved but the patient to still had a decreased TSH;  $<0.33 \mu\text{U/mL}$  (normal range:  $0.5\text{--}5.0 \mu\text{U/mL}$ ) and an increased T3;  $244 \text{ ng/dL}$  (normal range:  $115\text{--}190 \text{ ng/dL}$ ) and free T4 level  $18 \mu\text{g/dL}$  (normal range:  $5\text{--}12 \mu\text{g/dL}$ ). CBC differential was unremarkable. The patient was scheduled for discharge within the next 24 hours along with a management plan for the hyperthyroidism.

On day-5, the patient was discharged and discharge plan consisted of:

- Cefuroxime sodium 250 mg by mouth twice a day for ten days
- Salbutamol 2 mg by mouth four times a day for 14 days
- Methimazole 15 mg by mouth three times a day for 14 days
- Tamiflu 75 mg by mouth once a day for five days
- Rest and hydration

The patient chose to arrange follow-up appointments with the attending physician within the next two weeks at their outpatient office and adjust treatment regimen as needed to manage the hyperthyroidism.

## DISCUSSION

Hyperthyroidism with thyroid storm is a rare clinical case and may present with overwhelming complications. This should be overseen as mortality rates from thyroid storm alone ranges from 20–50% and complications such as infections, i.e., pneumonia, increases the risk furthermore. Due of the potentially high mortality rate, early diagnosis and treatment of thyroid storm is of the utmost importance [1]. Patients experiencing a thyroid storm are at a higher infection risk due to the fact that an overactive metabolic state acts as a catalyst to delay the neutrophil response towards sites of infection. Consequences of this physiologic process may lead to neutropenia (low white blood cell count in blood) where the body lacks its defense mechanism to fight infection. In a similar prospective and observational study conducted, all patients enrolled had an absolute neutrophil count (ANC) below  $2 \times 10^9/L$ , documented in at least three consecutive occasions within the last three months [2]. This process increases susceptibility to infections i.e., bacterial pneumonia, especially seen in this patient with a noted lower than normal absolute neutrophil count (ANC). The incidence of absolute neutropenia in hyperthyroid patients varied from less than 5–18% [3].

It should also be stated that the patient experienced similar episodes in the past. It cannot be coincidental but only fortifying the support a correlation between hyperthyroidism and infection risk does indeed exist. Several reported documents continue to prove a relationship between severe hyperthyroid states and infection acquisition whether it is either bacterial or viral [4–6]. Severe complications, fatal if not treated, may arise if a patient presents with symptoms of a thyroid storm and should be a diagnostic clue to expeditiously admit them to the ICU where they will be under close observation, as it is the standard of care in an acute intervention setting [7].

The role of hyperthyroidism and its risk for infection is primarily due to the hypermetabolic effect on the body. The increased sympathetic response causes a downward regulation of neutrophil response to areas of inflammation and/or infection. Devastating infectious complications such as pneumonia is an example that this patient experienced along with having similar episodes in the past but without causality to account for why were are recurrent. A comparable analysis by Rosenthal et al., exhibited similar findings [8].

Through the metabolic process of hyperthyroidism, it can be noted that it indeed does play a part to increase infection risk particularly since the patient had recurrent bouts of pneumonia. A similar case report by Lum et al., had related findings where *Streptococcus pneumoniae* was diagnosed in a patient with characteristics of hyperthyroidism via sputum gram stain [9]. Clinical diagnosis can either be confirmed via sputum gram stain, blood cultures, and/or urinary antigen testing. Urinary antigen testing has been proven to be a more favorable

confirmatory test due to its rapid success and minimum invasiveness compared to a bronchoalveolar lavage [10]. Clinical suspicion for diagnosing hyperthyroidism will vastly aid in the management of patient's more effectively and hopefully avoid any infectious complication that may result. It is entirely important that these patients should be closely monitored to help prevent any further complications that may present upon admission.

## CONCLUSION

Thyroid storm is a rare and life-threatening endocrinologic emergency that may be precipitated by trauma, surgery, systemic illness, particularly infection and sepsis. Prompt recognition and immediate treatment is vital to limit the concurrent morbidity and mortality associated with this condition.

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### Author Contributions

Andrew Dookhan – Substantial contributions to conception and design, Acquisition and analysis of data, Drafting the article, Revising it critically for important intellectual content, Final approval of the version to be published

Hiren Patel – Substantial contributions to conception and design, Acquisition and analysis of data, Drafting the article, Revising it critically for important intellectual content, Final approval of the version to be published

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Abhinav Sinha – Substantial contributions to conception and design, Acquisition and analysis of data, Drafting the article, Revising it critically for important intellectual content, Final approval of the version to be published

### Guarantor

The corresponding author is the guarantor of submission.

### Conflict of Interest

Authors declare no conflict of interest.

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