A Case Report on the Comparison of Healthy Thyroid Versus Cancerous Thyroid Metal Element Concentrations and Possible Environmental Influences on these Metal Elements

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Abstract

Background: Dendrochemistry, the measurement of element concentrations in tree rings to screen temporal changes in chemical environments, was used to study an area in south-central, North Carolina, USA, that has experienced a higher-than-expected incidence of a couple of illnesses including thyroid cancer.

Methods: We analyzed metal concentrations in tree rings of loblolly pine trees in the area in decadal segments of tree rings and three excised thyroid cancer tissues from three women afflicted with the disease.

Results: ICP-MS analyses showed a vastly different metal profile in the cancer thyroid tissue compared to normal thyroid tissue as well as increased thorium concentrations in the thyroid cancer tissues and in the most recent decade (the 2010s) of four tree's rings that were significantly higher than in the previous decades.

Conclusions: We believe our thorium data shows that thorium exposure may contribute to the development of 80 thyroid cancer.

Keywords: Thyroid cancer • Thorium • Dendrochronology

Background

In the world of public health, illnesses have background rates of incidence that are considered baseline minima. If or when the incidence rate of an illness for a discrete place and/or period exceeds the background rate for that illness, concern might arise that something is wrong. For example, in the late 1990s, Fallon, Nevada, USA experienced an unusual incidence rate of childhood leukemia, about 12X the background rate, which was dubbed “one of the most unique clusters of childhood cancer” ever reported [1].

Upon identifying even, the possibility of a public health problem in a place, a scientific investigation might be initiated for at least documenting the problem, as well as for, perhaps, searching for a cause of the higher-than-expected incidence of illness. A question inevitably emerges in investigations of public health problems: Has anything changed through time in or around the area of the problem? A method for assessing environmental change through time is dendrochronology, the study of tree rings. Traditional applications for dendrochronology include dating cultural and/or environmental events of the past or reconstructing climate back in time beyond human memory or meteorological record keeping [2,3].

Case Presentation

Procedures for securing human thyroid tissue: The three female thyroid cancer patients ordered their attending physician to contact Dr. Witten to send him the cancerous thyroid tissue for analyses after giving their consent for their excised thyroid cancer tissue to be studied for metal content. Dr. Witten communicated with the University of Arizona Human Subjects Committee his intent to measure the metal content of the cancerous thyroid tissue and was permitted by the committee to proceed with the study. This study was performed by the Declaration of Helsinki as revised in 2013.

Our dendrochronology study of the area in south-central North Carolina, USA showed most of the metal elements did not change with the period covered by the trees, but four elements (molybdenum, chromium, iron, and possibly vanadium) show concentrations in the most recent decade (the 2010s) that were higher than previous decades [4]. In normal healthy thyroid element concentrations are ranked in concentration in descending order as zinc, bromine, copper, selenium, and manganese [5]. However, in the three cancer thyroid tissues, the element sodium had the highest concentration and iron was ranked second in one cancer thyroid tissue and 4th in concentration in the other two cancer thyroid tissues. We believe that the high sodium levels were most likely from sodium iodide symporters used to treat thyroid cancer tumors by transport of radioiodine to the cancer cells [6]. Aluminum was the second-ranked element in two of the three cancer thyroid cancer tissues and the 6th-ranked element in the third cancer thyroid tissue. We also examined the radioactive elements of thorium and uranium in the afflicted area because of the presence of a coal-fired power plant in the area. In a 2007 study, it was found that uranium and thorium are found in coal and the coal combustion process concentrates uranium and thorium in the coal combustion particulate [7]. Additionally, there are over 65 published scientific manuscripts that show coal fly ash contains significant levels of vanadium which was found to be elevated in the tree rings of the afflicted area (www.pubmed.gov). We found that the uranium tree ring concentrations were very low (sub-parts per billion) however the three cancer thyroid tissues had an average of 2.06 (+/- 1.09) parts per million. Conversely, thorium levels in four tree rings were significantly elevated in the last decade (the 2010s) and thorium was found in all three cancer thyroid tissues at an average of 1.04 (+/- 1.02) parts per million (Figure 1). There are no known thorium deposits in North Carolina, but that does not exclude the possibility of an unknown thorium deposit in the afflicted area of south-central North Carolina. Another possibility of thorium exposure is from flaking inside aircraft jet engines where thorium is used in the hottest areas because of its property of little creep or expansion due to the high jet engine combustion temperatures (personal communication with Pat DeFao, June 9, 2023). Uranium radioactively decays by emitting an alpha particle. The half-life decay varies between 159,200 and 4.5 billion years. The most stable isotope of thorium has a half-life of 14.05 billion years via alpha particle decay [8].

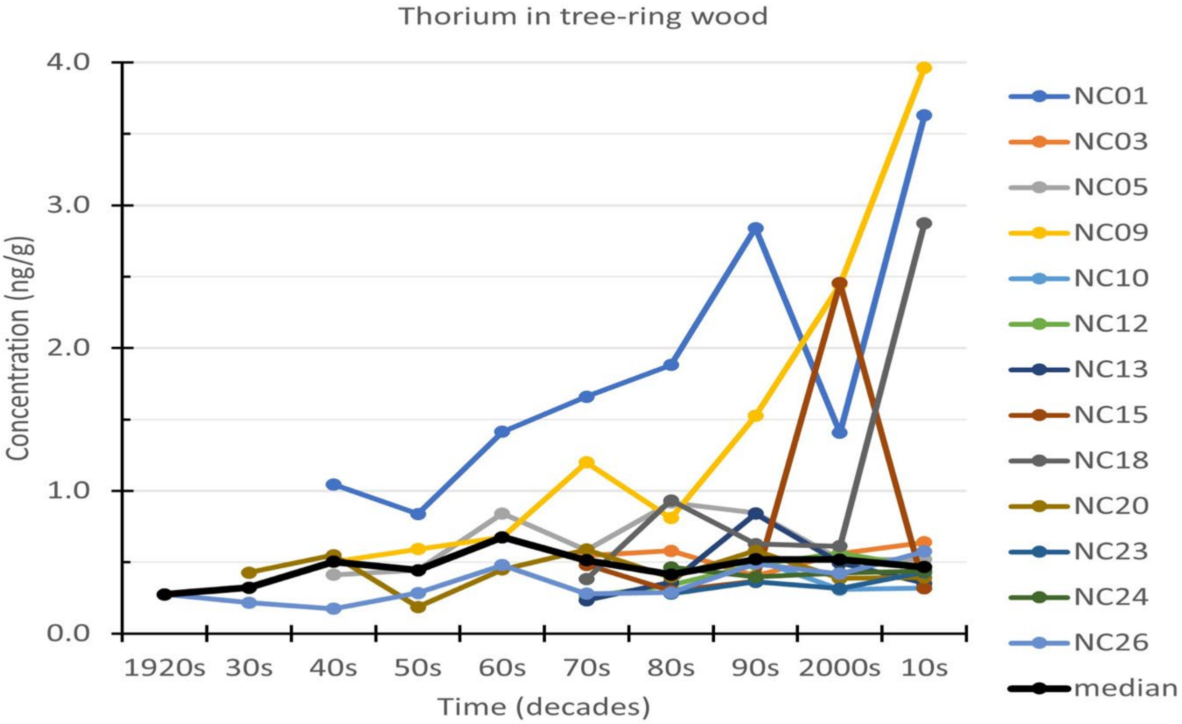

Figure 1. A graph of thorium in 13 Loblolly pine trees in a disease -afflicted area of south-central North Carolina with the Y-axis in thorium concentration (ng/gram of tissue) and the X-axis in decades of years. Four tree rings in the last decade (2010s) showed a significant increase in thorium concentrations ($p<0.05$). 264.

Conclusion

In summary, this case report shows that the cancerous thyroid tissue has a vastly different element profile compared to healthy thyroid tissue and the presence of iron and aluminum in the cancer thyroid tissue may be a source of metal oxides that contribute to the formation of cancer in the thyroid gland. The presence of radioactive elements in the cancerous thyroid tissue has obvious deleterious effects on healthy cells and a study published in 2020 found a significant association between thyroglobulin antibodies and anti-thyroid peroxidase in the general population and states within the USA that had high age-adjusted thyroid cancer incidence rates were associated with a high number of uranium activity locations and high uranium concentrations in the water [8].

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