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Review

Vitamin D, cod liver oil, sunshine, and phototherapy: Safe, effective and forgotten tools for treating and curing tuberculosis infections — A comprehensive review

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ABSTRACT

Tuberculosis remains an epidemic throughout the world, with over 2 billion people, or more than one third of the world's population, infected with TB. In 2015, there were an estimated 10.4 million new cases of tuberculosis, and 1.8 million deaths, making TB one of the top ten causes of death worldwide. Approximately 95% of new TB cases occur in developing countries, where the costs of treatment force many patients and their families into poverty. The United Nations and the World Health Organization are working to end this global epidemic. Historically, cod liver oil in the 1840′s, phototherapy in the 1890′s, sunshine in the 1890′s and 1930′s, oral vitamin D in doses of 100,000–150,000 international units a day the 1940′s, and injectable vitamin D in the 1940′s were all shown to be able to safely treat tuberculosis. However, for reasons that are unclear, these treatments are no longer being used to treat tuberculosis. We will review several reports that documented the clinical efficacy of these seemingly disparate treatments in treating tuberculosis. Taken together, however, these reports show the consistent efficacy of vitamin D in treating tuberculosis infections, regardless of whether the vitamin D was produced in the skin from the effects of phototherapy or sunshine, taken orally as a pill or in cod-liver oil, or put into solution and injected directly into the body. We will discuss how vitamin D, through its action as a steroid hormone that regulates gene transcription in cells and tissues throughout the body, enables the body to eradicate TB by stimulating the formation of a natural antibiotic in white blood cells, the mechanism of which was discovered in 2006. We will speculate as to why vitamin D, cod liver oil, sunshine, and phototherapy are no longer being used to treat tuberculosis, in spite of their proven efficacy in safely treating this disease dating back to the early 1800′s. In fact, in 1903 the Nobel Prize in Medicine or Physiology was awarded to a physician who was able to cure hundreds of cases of long-standing lupus vulgaris (cutaneous TB) with refracted light rays from an electric arc lamp. Vitamin D, cod liver oil, sunshine, and phototherapy have never been shown to lose their ability to safely eradicate tuberculosis infections, and deserve consideration to be re-examined as first-line treatments for tuberculosis. These treatments have the potential to help cost-effectively and safely end the global TB epidemic.

1. Introduction

Tuberculosis remains an epidemic throughout the world. It is estimated that over 2 billion people, or more than one third of the world's population, are infected with TB [1–3]. In 2015, there were an estimated 10.4 million new cases of tuberculosis, and 1.8 million deaths, making TB one of the top ten causes of death worldwide [3]. Both the United Nations and the World Health Organization are working to end the global tuberculosis epidemic, as approximately 95% of new TB cases occur in developing countries, where the costs of treatment force many patients and their families into poverty [1,3].

Antibiotics have been the mainstay of treatment for tuberculosis since the 1940′s. Streptomycin was discovered in 1943 [4,5], and reports soon followed showing it to be an effective treatment for curing tuberculosis infections [6,7]. In spite of the fact that resistance to antibiotics soon developed, antibiotic treatment of TB infections was so effective that in 1952 the Nobel Prize in Physiology or Medicine was awarded to Dr Selman Waksman for the discovery of streptomycin [8]. However, resistance to treatment with streptomycin and other antibiotics soon developed, and has remained a persistent problem since that time. Because of this, current treatment algorithms recommend starting with four drug regimens for patients infected with either

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pulmonary or miliary tuberculosis [9–11].

However, cod liver oil in the 1840′s [12], phototherapy in the 1890′s through the 1950′s [13–17], sunshine in the early 1900′s [18,19], oral vitamin D in the 1940′s [20–23], and injectable vitamin D in the 1940′s [24] were also independently shown to be able to safely cure tuberculosis infections, without concomitant antibiotic use. Interestingly, the 1903 Nobel Prize in Physiology or Medicine was also awarded to someone who developed a cure for TB. Dr Neils Ryberg Finsen was given the award after curing hundreds of cases of long-standing lupus vulgaris (cutaneous tuberculosis infections) by shining refracted light rays from an electric arc lamp onto the skin of infected patients in the 1890′s and early 1900′s [13–17]. He did this approximately 20 years before the discovery of vitamin D, and roughly 50 years prior to the discovery of antibiotics.

We will review reports that documented the clinical efficacy of these seemingly disparate treatment modalities in treating tuberculosis infections. We will then review a landmark study published in 2006 that ties them all together, by describing how vitamin D, through its action as a steroid hormone that regulates gene transcription in cells and tissues throughout the body, enables the body to eradicate TB by stimulating the formation of a natural antibiotic in white blood cells in response to their stimulation by tuberculosis antigens [25].

Taken together, these reports show the consistent ability and mechanism of action that enables vitamin D to treat tuberculosis infections, regardless of whether the vitamin D was produced in the skin from the effects of phototherapy or sunshine, taken orally as a pill or in cod-liver oil, or put into solution and injected directly into the body.

In order to better understand why these treatments aren't being used today, but deserve consideration to be re-examined as primary treatment modalities, we will also discuss:

a) reports on vitamin D toxicity from the 1930s and 1940s [26–28], and compare them to more contemporary reports [29–34];
b) data on the estimates of vitamin D production in the skin that were made in the 1970′s and 1980′s (and unknown in the 1940s), which range up to 25,000 IU a day [18,35–39];
c) several reports published in the same era describing the successful use of vitamin D in treating not only TB, but also asthma [40], rheumatoid arthritis [41], psoriasis [42], and rickets [43,44];
d) several recent vitamin D supplementation studies [45–49];
e) current controversies surrounding vitamin D supplementation involving the Institute of Medicine [50,51];
f) recent reports and reviews on the current use of vitamin D supplementation and testing in treating TB [52–62], and which appear to be using inadequate doses of vitamin D;
g) clinical trials from the 1980s and 1990s that showed both oral and topical vitamin D can safely control psoriasis [63–68]; and
h) clinical trials published in 2009 and 2010 that showed both sunshine and phototherapy can also safely control psoriasis [69–71].

2. Materials and methods

Beginning in 2009 a literature search was conducted by the authors looking for articles describing the treatment of human disease using cod liver oil, phototherapy, sunshine or vitamin D. The resulting discussion is taken from a review of several of these articles, with special focus on those that described the successful use of these varying modalities in treating and curing tuberculosis infections, which date from the 1840′s to the 1950′s [12–24].

It is notable that none of the references we are reviewing showing remarkable health benefits from the use of vitamin D, sunshine or phototherapy reported in the 1930s and 1940s for treating TB, asthma, rheumatoid arthritis and psoriasis, and again in the 1980s, 1990s and 2000s for treating psoriasis, were cited or discussed by the Institute of Medicine (IOM) in their 2011 Report on Dietary Reference Intakes for Calcium and Vitamin D [50,51].

In their report, the IOM concluded that other than for certain measures of bone health, they could find no other convincing evidence for health benefits attributable to vitamin D. This appears to be a significant oversight on their part. The IOM also recommended avoiding sunshine to reduce the risk of developing skin cancer, assumed that all the vitamin D that a person requires comes from the diet, and stated that most people would be vitamin D sufficient by taking 600 International Units (IU) of vitamin D a day, along with a 25-hydroxyvitamin D blood level of 20 ng/ml. These recommendations also appear to be misguided.

3. Results

3.1. Tuberculosis and cod liver oil − 1840′s

The use of cod liver oil to treat and cure tuberculosis infections dates back to at least the early 1800s. In 1849, Dr CJB Williams, a London physician, wrote a report detailing his experience in treating over 400 patients suffering from pulmonary tuberculosis using cod liver oil [12]. He kept very good notes in 234 of the cases, which formed the basis of his report, in which he provides both a summary of his experience, as well as clinical descriptions of 11 individual cases.

In summary he stated that: "Out of this number, the oil disagreed, and was discontinued, in only nine instances. In nineteen, although taken, it appeared to do no good; whilst in the large proportion of 206 out of 234, its use was followed by marked and unequivocal improvement; this improvement varying in degree in different cases, from a temporary retardation of the progress of the disease, and a mitigation of distressing symptoms, up to a more or less complete restoration to apparent health."

He provided excellent descriptions of physical exam findings, thought processes as to when to use cod liver oil and how much to give, and individual patient responses to treatment. Many of his patients were cured, and marked improvement in their condition was often noted within a few days:

> "The most numerous examples of decided and lasting improvement, amounting to nearly 100, have occurred in patients in what is usually termed the second stage of the disease, in which the tuberculosis deposits begin to undergo the process of softening, the common physical signs being defective movement and breath-sound, with muco-crepitation and marked dullness below or above a clavicle, or above a scapula, and tubular breath and voice-sounds towards the root, or inner part of the apex of the same lung."

> "The effect of the Cod-liver oil in most of these cases was very remarkable. Even in a few days, the cough was mitigated, the expectoration diminished in quantity and opacity; the night-sweats ceased; the pulse became slower and of better volume; and the appetite, flesh, and strength were gradually improved."

At the end of the introduction, prior to describing the individual cases, he wrote a paragraph describing his experience in treating patients with advanced disease, which leaves little doubt as to the efficacy of the treatment:

> "The most striking instance of the beneficial operation of Cod-liver oil in phthisis, is to be found in cases in the third stage, even those far advanced, where consumption has not only excavated the lungs, but is rapidly wasting the whole body, with copious purulent expectoration, hectic night sweats, colliquative diarrhoea, and other elements of that destructive process by which, in a few weeks, the finest and fairest of the human family may be sunk to the grave. The power of staying the demon of destruction, sometimes displayed by the Cod-liver oil, is so marvellous, that I will attempt no general description, but will merely quote from my notebooks brief abstracts of a few specimen cases, that shall plead for themselves."