



Mini Review

Volume 8 Issue 2 – November 2017
DOI: 10.19080/ARGH.2017.08.555731

Adv Res Gastroentero Hepatol

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The Intersection of Aging and Cancer



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Submission: September 17, 2017; **Published:** November 27, 2017

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Abstract

Life expectancy increases. Many developed countries are experiencing an increase in older individuals, both in terms of absolute numbers and by means of proportion of the total population. Ageing is fundamental factor for the development of cancer. The incidence of cancer rises intensely with age, most likely due to a build-up of risks for specific cancers that increase with age. The overall risk accumulation is conjoined with the tendency for cellular repair mechanisms to be less effective as person grows older.

Screening aims to identify individuals with abnormalities suggestive of a specific cancer or pre-cancer who have not developed any symptoms and refer them promptly for diagnosis and treatment.

Keywords: Elderly; Cancer; Chronic-non-infectious diseases; Organ impairment; Autoimmune diseases; Trace elements and metals

Introduction

As life expectancy increases, many countries are experiencing an increase in older individuals, both in terms of absolute numbers and as a proportion of the total population. In 1999, for example, in every day, more than 6,000 Americans celebrated their 65th birthday [1].

a. In 2004, in the United States, there were an estimated 60,800 centenarians [2].

b. In the same year, one out of every eight people (approximately 12.4% of the population) was an older person [3].

c. Since 1900, the 65 and older population had doubled three times [4].

d. During the same century, the population of oldest old Americans (those aged 85 and older) grew from just over 100,000 to 4.2 million [5].

e. The number of people aged 100 and older increased 36% between 1990 and 2003 growing from 37,306 to 50,639 [3].

Excessive zinc loss is a common complication of different organs' impairment in the ageing population and as a result of longstanding common chronic non-infectious and autoimmune diseases that are prevalent in the ageing population (Table 1). Screening programmes can be effective for detecting cancers when appropriate tests are used, implemented effectively and properly linked to other steps in the screening program.

Table 1: Major Causes of Zinc Deficiency in the elderly.

Inadequate intake
(1). Enteral alimentation
(2). Haemolytic anaemia
(3)Intravenous alimentation
Malabsorption
(4) During intravenous alimentation
(5) Malabsorption syndrome:
(a). Liver dysfunction
(b). Pancreatic dysfunction,
©Inflammatory bowel diseases
(d). short bowel syndrome
(5) Excessive loss
(a). Intestinal fistula,
(b). Increased urinary elimination:
©Prolonged intravenous alimentation
(d)Liver cirrhosis
(e). Diabetes mellitus
(f). Renal disease
(g). Shortage of nutrient intake enhanced catabolism (surgery, trauma, infection, etc...),
(h)Diuretics
(i).Haemodialysis

Zinc deficiency and gastrointestinal cancer

In a published report in 2005, Boz A et al. [6] assessed the plasma levels of zinc, copper and ceruloplasmin in 25 patients who underwent surgery for gastrointestinal cancers and compared the results with those of 20 healthy controls. The blood samples were taken preoperatively from the patients. In this study, levels of Cu and Zn were defined with calorimetric measure and ceruloplasmin levels were measured with immunohistochemical assay. The decrease in Zn levels and the increases in the levels of both of ceruloplasmin and Cu, in patients with gastrointestinal cancers were found to be significant ($p < 0.001$, $p = 0.014$ and $p = 0.019$, respectively) when compared to those of the control group. In the patient group, the correlations between serum Cu and serum ceruloplasmin proved to be significant ($r = 0.991$, $p < 0.001$). The Cu/Zn ratio, when compared with Zn, ceruloplasmin and Cu, showed significant results ($r = 0.562$, $r = 0.500$, $r = 0.506$, $p < 0.001$).

These findings were positively supporting the earlier published results [7]. In the latter study, the serum levels of Cu/Zn SOD were significantly elevated in gastric cancer patients compared with healthy controls.

Discussion

Deficiency of zinc has multiple carcinogenic consequences, including effects on mutagenesis, DNA repair, DNA synthesis, cell proliferation, apoptosis and differentiation, and on the cellular anti-oxidant balance [8]. To the contrary, zinc replenishment exerts preventive effects on mutagenesis and cell transformation by at least three mechanisms:

- a. Zinc is a potent anti-oxidant agent, in particular through its capacity to bind and protect sulfhydryls in proteins from the drastic attacks;
- b. Zinc is a co-factor, which regulates the catalytic activity of over 300 enzymes belonging to all major classes of mammalian enzymes; and
- c. Zinc binds to specific residues in protein and stabilizes protein tertiary and quaternary structures [8-13].

In addition, the antioxidant roles of zinc include the removal of superoxide ions by superoxide dismutase impairing hydroxyl ion formation by redox-active transition metals like copper and iron [14] and the regulation of expression and activity of metallothioneins (a major class of metal and radical buffer proteins involved in many stress responses and detoxification reactions) [8,15].

Not only the development of malignant tumours is closely linked to the deficiency of zinc [16] but the activity of the cancer is also directly linked to the severity of the zinc deficiency [17]. Thence, the improvement in the life expectation must be accompanied with the appropriate plans for improving the elderly patients' care and

their quality of life. To that effect, the present study emphasises on the crucial importance of conducting regular screening for the deficiency of zinc in the elderly and on its replenishment.

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DOI: [10.19080/ARGH.2017.08.555731](https://doi.org/10.19080/ARGH.2017.08.555731)

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