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Risks of Pancreatic Cancer and Dietary Glucosinolates

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Mini Review

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Abstract

Pancreatic cancer has poor prognosis and is detected in the late stages usually. There is no way for specific prevention of pancreatic cancer. Brassicaceae vegetable-produced glucosinolates and isothiocyanates are known as anticancer substances. Aim of this mini-review was to estimate opportunities of pancreatic cancer prevention by glucosinolates and their derivatives. Results of ten clinical and epidemiologic studies were discussed. It was shown no clear and solid evidence for positive effects of glucosinolates, isothiocyanates or plants containing these substances in pancreatic cancer prevention or treatment have been observed.

Keywords: Glucosinolates; Brassicaceae Vegetables; Pancreatic Cancer; Prevention; Incidence Risk

Introduction

Pancreatic cancer is a relatively rare disease. According to American Cancer Society's statistics pancreatic cancer is linked to about 3% of all cancer cases in US. At the same time, about 7% of all cancer deaths in the USA are associated with pancreatic tumors. In 2018 pancreatic cancer accounted for 2.5% of all cancer cases and 4.5% of all cancer deaths. The age-standardized incidence rate was 7.7 per 100,000 people in Europe and 7.6 per 100,000 people in North America [1]. Pancreatic cancer has poor prognosis due to fast development and late diagnosis with 5-year relative survival rates 10%. Increase in pancreatic cancer incidence and mortality was observed for last year's [2]. Adenocarcinoma is the most common pancreatic tumor (85-95% cases) [3,4]. Unfortunately, there is no way for specific prevention of pancreatic cancer [4,5]. It is known that diet can modify incidence risk of some cancer [6] but a very few studies were focused on pancreatic cancer [5,7]. It is clear that risk of pancreatic cancer is positively correlated with elevated body mass index [2-5]. Studies of 'dietary patterns' or some food groups effects showed contradictory results. On the other hand, some edible plants contain metabolites with antitumor activity. In particular, the Brassicaceae family vegetables produce secondary metabolites called glucosinolates [8]. During food processing, glucosinolates are degraded to isothiocyanates [9] with well-documented antitumor and cancer-preventing properties [10,11]. Aim of this mini-review was to estimate opportunities of pancreatic cancer prevention by glucosinolates and their derivatives.

Ways to Estimate Protective Effects of Glucosinolates and their Derivatives on Pancreatic Cancer Development

Direct evidence of effects of glucosinolates and their derivatives can be taken from clinical and epidemiological studies. Studies can utilize various sources of glucosinolates

and their derivatives: individual substances (e.g., glucosinolate glucoraphanin or isothiocyanate sulforaphane; such a study has strongest level of interpretability); purified mixtures of glucosinolates and/or their derivatives; crude extracts from Brassicaceae plants and, finally, whole edible Brassicaceae plants (studies with weakest interpretability). On the other hand, the last kind of study is most relevant to real public health support.

Effects of Brassicaceae Vegetables Nutritional Consumption

Four prospective cohort studies and five case-control studies of Brassicaceae vegetable consumption influence pancreatic cancer incidence risk have been published to date. Three large studies provided no evidence that Brassicaceae vegetables had protective action on pancreatic cancer development. For example, the prospective Hawaii–Los Angeles Multiethnic Cohort Study was performed in 1993-2002 in the USA and enrolled 183,552 participants. In this study no evidence of pancreatic cancer relative risk modification by Brassicaceae vegetables was found (adjusted RR = 0.83, 95% CI: 0.62-1.12 for upper versus lower quintiles of Brassicaceae vegetables consumption level) [12]. Large cohort study undertaken in 1986-2002 in the Netherlands (120,852 participants) did not support hypothesis that Brassica vegetables could decrease risk of pancreatic cancer. Multivariate-adjusted hazard ratio (HR) was 1.24 (95% CI: 0.88-1.74; for upper versus lower quintiles of Brassica vegetable consumption level).

Prospective cohort study performed in Sweden (1997-2004, 81,922 participants) didn't determine protective action of all Brassicaceae vegetables too (multivariate HR = 0.70; 95% CI: 0.43-1 [13]. For 3 or more servings per week versus <1 serving per week) as same as broccoli or Brussels sprouts (multivariate HR = 0.82; 95% CI: 0.43-1.41 for at least one serving per week versus no consumption) and cauliflower (multivariate HR = 0.71; 95% CI: 0.40-1.24 for at least one serving per week versus no consumption)]. On the other hand, this study found protective action of cabbage consumption (multivariate HR = 0.62; 95% CI: 0.39-0.99 for at least one serving per week versus no consumption) [14]. However, the upper limit of 95% CI was very close to 1. This fact allows us to suppose that the effect of cabbage can be as real (but weak) and imaginary due to experimental or statistical bias. We suggest the probable effect of cabbage consumption on pancreatic cancer incidence risk should be re-evaluated in advanced prospective study.

Nine studies undertaken in 1986-2012 were combined in meta-analysis performed by Li, et al. [15]. Only one out of nine included studies provided a protective effect of Brassicaceae vegetables on pancreatic cancer risk (HR = 0.50, 95% CI: 0.40-0.80). Overall HR of meta-analysis was 0.78 (95% CI: 0.64-0.91). However, the positive result of this meta-analysis has some limitations and should be viewed with caution. Firstly, positive value of overall HR was achieved through a single small (2,439 participants) case-control study. Secondary, combining data from high-quality studies or prospective studies only showed neutral effects of Brassicaceae vegetables on pancreatic cancer risk.

Effects of Brassicaceae Plant Extracts

We found only one finished study of glucosinolate-rich dietary supplement pharmacological effects. POUDER trial tested therapeutic effects of glucoraphanin + sulforaphane-enriched broccoli preparation in patients with advanced pancreatic adenocarcinome. Observed effects were not statistically significant [16].

Effects of Purified Glucosinolates and/or Isothiocyanates Mixture or Individual Substances

No relevant research publication has been found.

Conclusion

There are not clear and solid evidence for positive effects of glucosinolates, isothiocyanates or plants containing these substances in pancreatic cancer prevention or treatment. On the other hand, glucosinolates and their derivatives inhibit proliferation and growth of pancreatic adenocarcinoma cells in cellular and animal experiments. Moreover, glucosinolates and their derivatives exhibit antitumor action against some other cancer types. Additional studies are needed to answer whether glucosinolates and isothiocyanates have protective properties against pancreatic cancer.

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