Deciphering potential health impacts of radioactive medical waste: *in silico* analysis of iodine-131 and technetium-99m's biological interactions

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Introduction

- The escalating use of radioactive materials in medical applications has generated a significant increase in radioactive medical waste, posing substantial risks to healthcare workers, patients, and general public.
- Iodine-131 and technetium-99m, crucial radionuclides with widespread applications in nuclear energy, medical treatments, and diagnostics, have emerged as focal points of interest.
- Understanding the combined impact of these radionuclides on human health, particularly in mixtures, is lacking, while adequate attention to identifying and validating biomarkers for early detection is crucial for assessing individual susceptibility and enabling timely interventions to mitigate potential health risks.

Aim of the study

to utilize toxicogenomic data mining techniques to elucidate the mechanisms through which iodine-131 and technetium-99m, both individually and in combination, elicit adverse effects.

Materials and methods

- Comparative Toxicogenomics Database (CTD) (https://ctdbase.org)
- Search Tool for Interactions of Chemicals (STITCH) (http://stitch.embl.de)
- GeneCards database (https://www.genecards.org)
- GeneMANIA server (https://genemania.org)
- ToppGene suite (https://toppgene.cchmc.org)

^{131}I

^{99m}Tc

Conclusions

The coexistence of iodine-131 and technetium-99m in a mixture may result in complex and dynamic interactions within biological systems, underscoring the necessity for a comprehensive understanding of their combined effects on health, particularly in scenarios involving simultaneous exposure.

Results

- Iodine-131 interacted with 13 genes related to thyroid function, glucose transport, and cellular processes. Majority of these genes belonged to the same pathway (30.22%) or were in genetic interactions (25.69%) (Fig. 1A).
- Technetium-99m interacted with 10 genes associated with cellular transport, endocrine functions, and cellular responses. Majority of these genes were in co-expression (86.77%) (Fig. 1B).
- The combined interactions revealed a diverse range of molecular functions, biological processes, and pathways, emphasizing the interplay between thyroid functions and cellular transport mechanisms.
- The overlapping SLC5A5 gene suggested a shared mechanism between the two radioisotopes.

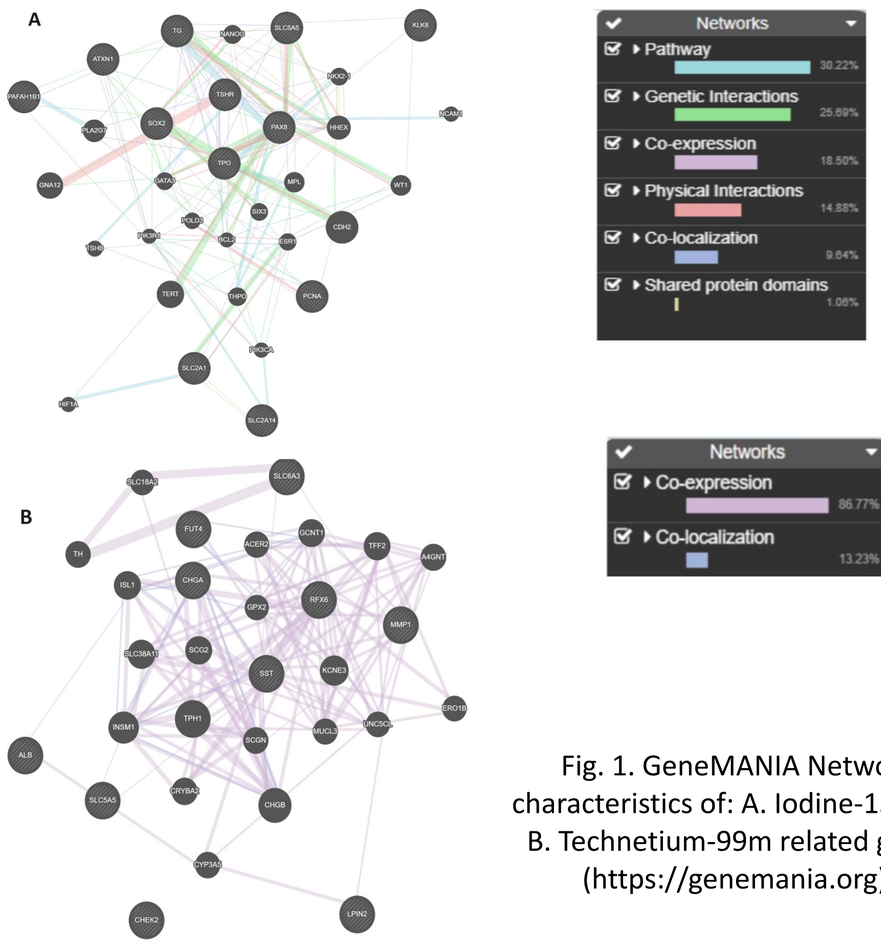

Fig. 1. GeneMANIA Network characteristics of: A. Iodine-131 and B. Technetium-99m related genes (https://genemania.org).

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