ISSN: 2476-2067

Toxicology: Open Access

Ke ords: Nano toxicology; Nanoparticles; Health e ects; Toxicity mechanisms; Risk assessment

Introd ction

Nanoparticles (NPs), de ned as materials with at least one dimension less than 100 nanometers, exhibit unique physical, chemical, and biological properties compared to their bulk counterparts [1]. ese distinctive characteristics have led to the widespread incorporation of nanoparticles in various consumer products, industrial processes, and biomedical applications [2,3]. However, along with the rapid proliferation of nanotechnology, concerns regarding the potential adverse e ects of nanoparticles on human health and the environment have emerged. Nano toxicology has thus emerged as a crucial discipline aimed at assessing and mitigating the risks associated with nanomaterial exposure. Nanotechnology, with its remarkable ability to manipulate matter at the nanoscale, has sparked tremendous innovation across diverse elds, ranging from electronics and medicine to environmental remediation [4]. Engineered nanoparticles (NPs), de ned as materials with dimensions typically less than 100 nanometers, exhibit unique physical, chemical, and biological properties that distinguish them from their bulk counterparts [5]. ese distinctive characteristics have paved the way for groundbreaking advancements, such as targeted drug delivery systems, enhanced imaging modalities, and novel materials with tailored functionalities. However, alongside the promise of nanotechnology, concerns have arisen regarding the potential risks posed by exposure to engineered nanoparticles [6,7]. e intricate

Citation:

been implicated in promoting inflammation through activation of pro-inflammatory pathways and recruitment of immune cells, which can exacerbate tissue injury and contribute to chronic diseases. Moreover, the genotoxic potential of nanoparticles, manifested as DNA damage and chromosomal aberrations, poses concerns regarding their carcinogenicity and mutagenicity. Disruption of cellular signaling pathways by nanoparticles further perturbs homeostatic mechanisms, potentially leading to aberrant cellular responses and adverse health outcomes. Understanding the multifaceted toxicological effects of nanoparticles is paramount for elucidating their health risks and guiding the development of effective mitigation strategies.

Factors influencing nanoparticle toxicity

Several factors modulate the toxicity of nanoparticles, necessitating a nuanced understanding of their interactions with biological systems. Shape anisotropy can influence cellular uptake and intracellular trafficking, affecting the biological response to nanoparticles. Surface charge and composition dictate the protein corona formation and subsequent cellular interactions, influencing nanoparticle biocompatibility and toxicity. Furthermore, the physicochemical stability of nanoparticles in biological environments can impact their long-term fate and toxicity profiles.

Challenges and future directions

Despite significant advancements, nano toxicology faces several challenges that warrant further investigation. The lack of standardized toxicity testing protocols and the heterogeneity of nanomaterials pose challenges in assessing and comparing their toxicological profiles. Moreover, the long-term effects of chronic nanoparticle exposure and their potential accumulation in biological systems remain poorly understood. Addressing these knowledge gaps requires interdisciplinary collaboration between toxicologists, material scientists, engineers, and clinicians. Furthermore, the development of innovative methodologies, such as advanced in vitro models and computational toxicology approaches, holds promise for enhancing the predictive power of nano toxicology studies.

Conclusion

Nano toxicology plays a pivotal role in elucidating the potential health risks associated with nanomaterial exposure and informing risk assessment and regulatory decisions. Understanding the complex interactions between nanoparticles and biological systems is essential for the safe development and utilization of nanotechnology across diverse applications. Continued research efforts aimed at unraveling the toxicity mechanisms, identifying biomarkers of exposure and effect, and assessing the long-term implications of nanoparticle exposure are imperative to ensure the responsible advancement of nanotechnology for the benefit of society.

References

1. Shafee G, Qorbani M, Heshmat R, Mohammadi F, Sheidaei A (2019) Socioeconomic inequality in cardio-metabolic risk factors in a nationally representative sample of Iranian adolescents using an Oaxaca-Blinder decomposition method: the CASPIAN-III study. J Diabetes Metab Disord 18: 145-153.
2. Gil-Rendo A, Muñoz-Rodríguez JR, Domper Bardají F, Menchén Trujillo B, Martínez-de Paz F (2019) Laparoscopic Sleeve Gastrectomy for High-Risk Patients in a Monocentric Series: Long-Term Outcomes and Predictors of Success. Obes Surg 29: 3629-3637.
3. de Paris FGC, Padoin AV, Mottin CC, de Paris MF (2019) Assessment of Changes in Body Composition During the First Postoperative Year After Bariatric Surgery. Obes Surg 29: 3054-3061.
4. Ogden CL, Carroll MD, Kit BK, Flegal KM (2013) Prevalence of obesity among adults: United States, 2011-2012. NCHS Data BriefOct: 1-8.
5. Apovian CM (2016) Obesity: definition, comorbidities, causes, and burden. Am J Manag Care; 22: 176-85.
6. Desogus D, Menon V, Singhal R, Oyebode O (2019) An Examination of Whom Is Eligible and Who Is Receiving Bariatric Surgery in England: Secondary Analysis of the Health Survey for England Dataset. Obes Surg 29: 3246-3251.
7. Thorell A, MacCormick AD, Awad S, Reynolds N, Roulin D (2016) Guidelines for Perioperative Care in Bariatric Surgery: Enhanced Recovery After Surgery (ERAS) Society Recommendations. World J Surg 40: 2065-83.
8. Ostruszka P, Ihnát P, Tulinský L, Vávra P (2019) An alternative method of surgical treatment in refractory GERD following laparoscopic sleeve gastrectomy. Rozhl Chir 98: 214-218.
9. Grover BT, Morell MC, Kothari SN (2019) Defining Weight Loss After Bariatric Surgery: a Call for Standardization. Obes Surg 29: 3493-3499.
10. Guzmán HM, Sepúlveda M, Rosso N, San Martin A, Guzmán (2019) FIncidence and Risk Factors for Cholelithiasis After Bariatric Surgery. Obes Surg 29: 2110-2114.