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Raman Spectroscopic Detection of the Diminishing Toxic Effect of Renal Waste Creatinine by Its in vitro Reaction with Drugs N-Acetylcysteine and Taurine

Authors : Debraj Gangopadhyay, Moumita Das, Ranjan K. Singh, Poonam Tandon

Abstract : Creatinine is a toxic chemical waste generated from muscle metabolism. Abnormally high levels of creatinine in the body fluid indicate possible malfunction or failure of the kidneys. This leads to a condition termed as creatinine induced nephrotoxicity. N-acetylcysteine is an antioxidant drug which is capable of preventing creatinine induced nephrotoxicity and is helpful to treat renal failure in its early stages. Taurine is another antioxidant drug which serves similar purpose. The kidneys have a natural power that whenever reactive oxygen species radicals increase in the human body, the kidneys make an antioxidant shell so that these radicals cannot harm the kidney function. Taurine plays a vital role in increasing the power of that shell such that the glomerular filtration rate can remain in its normal level. Thus taurine protects the kidneys against several diseases. However, taurine also has some negative effects on the body as its chloramine derivative is a weak oxidant by nature. N-acetylcysteine is capable of inhibiting the residual oxidative property of taurine chloramine. Therefore, N-acetylcysteine is given to a patient along with taurine and this combination is capable of suppressing the negative effect of taurine. Both N-acetylcysteine and taurine being affordable, safe, and widely available medicines, knowledge of the mechanism of their combined effect on creatinine, the favored route of administration, and the proper dose may be highly useful in their use for treating renal patients. Raman spectroscopy is a precise technique to observe minor structural changes taking place when two or more molecules interact. The possibility of formation of a complex between a drug molecule and an analyte molecule in solution can be explored by analyzing the changes in the Raman spectra. The formation of a stable complex of creatinine with N-acetylcysteinein vitroin aqueous solution has been observed with the help of Raman spectroscopic technique. From the Raman spectra of the mixtures of aqueous solutions of creatinine and N-acetylcysteinein different molar ratios, it is observed that the most stable complex is formed at 1:1 ratio of creatinine andN-acetylcysteine. Upon drying, the complex obtained is gel-like in appearance and reddish yellow in color. The complex is hygroscopic and has much better water solubility compared to creatinine. This highlights that N-acetylcysteineplays an effective role in reducing the toxic effect of creatinine by forming this water soluble complex which can be removed through urine. Since the drug taurine is also known to be useful in reducing nephrotoxicity caused by creatinine, the aqueous solution of taurine with those of creatinine and N-acetylcysteinewere mixed in different molar ratios and were investigated by Raman spectroscopic technique. It is understood that taurine itself does not undergo complexation with creatinine as no additional changes are observed in the Raman spectra of creatinine when it is mixed with taurine. However, when creatinine, N-acetylcysteine and taurine are mixed in aqueous solution in molar ratio 1:1:3, several changes occurring in the Raman spectra of creatinine suggest the diminishing toxic effect of creatinine in the presence ofantioxidant drugs N-acetylcysteine and taurine.

Keywords : creatinine, creatinine induced nephrotoxicity, N-acetylcysteine, taurine
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