MODERATED POSTER

An In-vitro Study in the Determination of the Permeability of Foley Catheter to Ciprofloxacin

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Objective: To examine the ability of an antimicrobial agent Ciprofloxacin to diffuse through a Foley catheter retention balloon.

Methods: The Ultraviolet-Visible (UV-Vis) Spectophotometer (UV-1700 PharmaSpec) was utilized to detect the diffusion of the analyte (Ciprofloxacin) through end parameters such as peak absorbance and corresponding wavelengths.

Results: On UV-Vis spectrophotometry, the control sample of sterile water was analyzed and found to have the lowest peak absorbance value of only 0.003 at a wavelength of 343 nm. The peak absorbance values of subsequent samples, taken from the same environment (sterile water), since submersion of the catheter balloon, on day-3, day-8, day-15 had increasing peak absorbance values on their corresponding wavelengths.

Conclusions: In this study, the samples of sterile water from the outside environment of the submerged catheter yielded progressively increasing peak absorbance values on the succeeding days of submersion. Thereby, In lieu of this principle, one can infer the diffusion of the analyte through the catheter membrane, as reflected by the summary of peak absorbance values.

Key words: permeability, diffusion, foley catheter, ciprofloxacin

Introduction

In 1995, Bibby, et al. proposed that catheter retention balloons be utilized to act as a reservoir to deliver antimicrobial substances into the bladder via sustained release through the balloon membrane.[1]

Subsequently, they conducted experimental trials using the biocide triclosan, which was found to diffuse through the catheter retention balloons of silicone catheters.[1]

As the Beer-Lambert Law states, "the concentration of an analyte is directly proportional to the amount of light absorbed, or inversely proportional to the logarithm of the transmitted light".[2] This law enables correlation of the intensity of UV-visible radiation absorption to the concentration of the substance in a sample.[3]

Spectrophotometry is a technique that determines the analyte concentration by utilizing the absorbance of light by an analyte (the substance to be analyzed) at a certain wavelength.[4]

In UV/Vis (ultra violet/visible) spectrophotometry, the absorbance of a solution (the measure of how much light is absorbed), is plotted against the wavelength of the light reaching the solution.[4] This absorbance spectrum is then presented as a graph of absorbance versus wavelength.[5] Thus, the higher the analyte concentration, the more light of a particular wavelength is absorbed, and thereby, the higher the absorbance value.[4] Absorbance values range from 0 (no absorption) to 2, which represents 99% absorption.[5]

This in-vitro study was done to determine the possibility of diffusion of a substance within the foley catheter retention balloon, towards its external environment, upon which it is being submerged. This will be determined via UV-Vis spectrophotometry (UV-1700 PharmaSpec),[6] through parameters such as wavelengths and absorbance values.

Materials and Methods

Materials used were the following:

- 50 cc sterile water in a sterile bottle
- Ciprofloxacin 400 mg vial (Ciprobay)
- Sterile 10cc syringe
- Foley catheter F16
- UV-1700 PharmaSpec

A 10cc sterile water was aspirated from the bottle of 50cc sterile water via a 10cc sterile syringe. This was then set aside for sending to the lab for UV-Vis Spectroscopy (UV-1700 PharmaSpec)

A 10cc sterile water was then instilled into the vial containing 400 mg Ciprofloxacin for dilution. The dilution was then aspirated via a 10cc sterile syringe, and was used to inflate the balloon of the F16 foley catheter.

A small hole was created on the upper part of the bottle containing the sterile water through which the distal end of the Foley catheter with the inflated balloon was inserted and allowed to submerge.

Samples of the sterile water from the bottle wherein the Foley catheter balloon inflated with Ciprofloxacin was submerged were taken amounting to 10cc each via sterile syringe on Day 3, Day 8, Day 15 from the time of submersion.

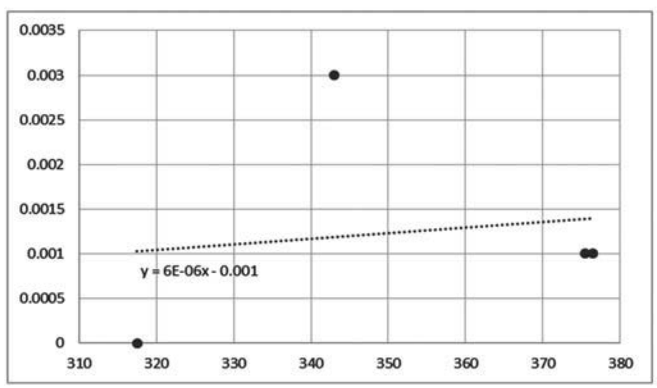
Each of the samples was brought to the laboratory on the day of collection, and was subjected to UV-Vis Spectroscopy via the UV-1700 PharmaSpec, to detect diffusion of Ciprofloxacin through catheter balloons.

The results were analysed using linear regression.

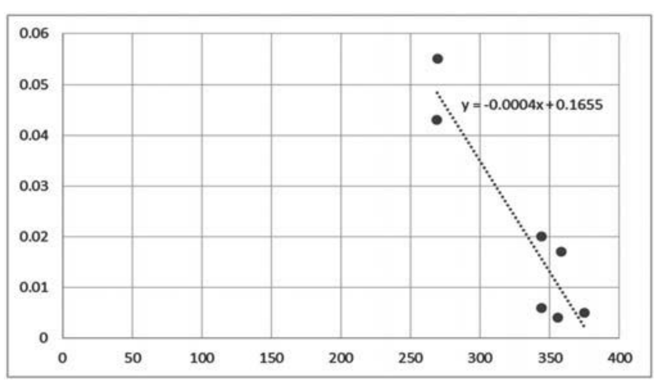
Results

On UV-Vis spectrophotometry, the control sample of sterile water was analyzed and was found to have peak absorbance value of only 0.003 at a wavelength of 343 nm. On the 3rd day since submersion of the catheter balloon, the sample of sterile water was analyzed, showing a higher peak absorbance value of 0.055 at a wavelength of 269.5. The 3rd sample of sterile water taken from the same environment was tested on the 8th day, with a much higher peak absorbance value of 0.056 at a wavelength of 272.50 nm. On the 15th day, the final sample of sterile water was tested, which yielded the highest peak absorbance value of 0.224 at the lowest wavelength of 264nm.

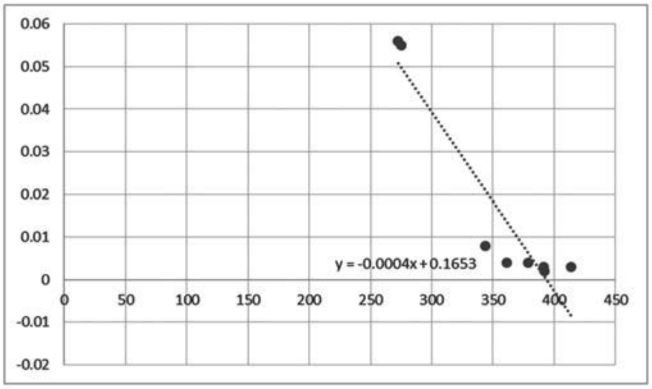
I. Linear regression of sample 1 (10cc sterile water) - control



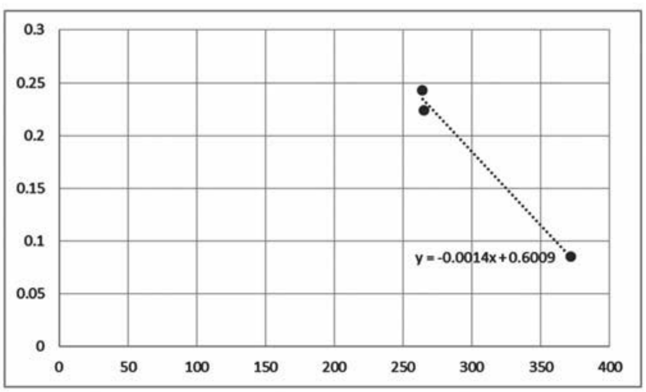
II. Linear regression of sample 2 (10cc sterile water on day 3 post-submersion of ciprofloxacin-containing catheter)



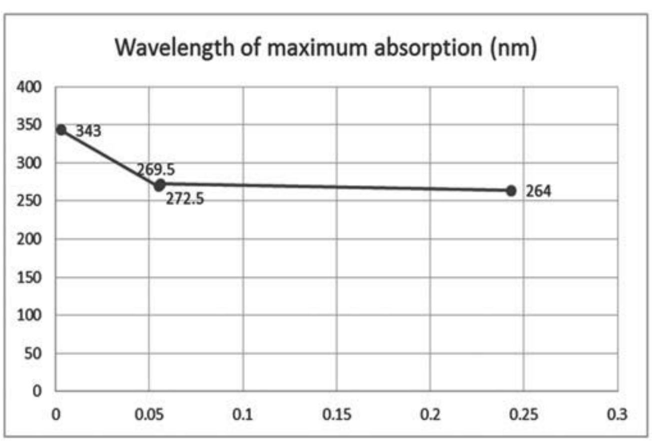
III. Linear regression of sample 3 (10cc sterile water on day 8 post-submersion of ciprofloxacin-containing catheter)



IV. Linear regression of sample 4 (10cc sterile water on day 15 post-submersion of ciprofloxacin-containing catheter)



V. Summary of the wavelengths with the highest absorbance per sample



Discussion

On UV-Vis spectrophotometry, the control sample of sterile water was analyzed and yielded the lowest peak absorbance value of only 0.003 at a wavelength of 343 nm. The peak absorbance values of subsequent samples, taken on day-3, day-8, day-15 from the same environment (sterile water) since submersion of the catheter balloon, showed increasing peak absorbance values on their corresponding wavelengths.

It is given that in UV/Vis spectrophotometry, the absorbance spectrum is then presented as a graph of absorbance versus wavelength.[3] The higher the analyte concentration, the higher the absorbance value due to more light of a particular wavelength absorbed.

In this study, the samples of sterile water from the outside environment of the submerged catheter yielded progressively increasing peak absorbance values on the succeeding days of submersion. Thereby, in lieu of this principle, one can infer the diffusion of the analyte through the catheter membrane, as reflected by the summary of peak absorbance values.

Conclusion

This study only described the potential diffusion of an analyte (Ciprofloxacin) via UV-Vis sphectrophotometry, which was reflected by the increasing peak absorbance values on corresponding wavelengths through time of catheter submersion. The results can be of value for the potential use of a catheter retention balloon to act as a reservoir to deliver antimicrobial substances into the bladder via sustained release through the balloon membrane. It is recommended, though, to use high-performance liquid chromatography (HPLC), a technique in analytical chemistry used to separate, identify, and quantify each component in a mixture. Also, further studies can be done to test other substances as well.

References

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