1040-5488/13/9010-1057/0 VOL. 90, NO. 10, PP. 1057–1065
OPTOMETRY AND VISION SCIENCE

ORIGINAL ARTICLE

Factors that Influence *In Vitro* Cholesterol Deposition on Contact Lenses

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ABSTRACT

Purpose. The purpose of this study was to analyze the impact that incubation time, lipid concentration, and solution replenishment have on silicone hydrogel (SiHy) and conventional hydrogel (CH) contact lens cholesterol deposition via *in vitro* radiochemical experiments.

Methods. Four SiHy (senofilcon A, lotrafilcon B, comfilcon A, balafilcon A) and two CH (etafilcon A and omafilcon A) contact lenses were incubated in an artificial tear solution (ATS) that contained major tear film proteins, lipids, salts, salts, and a trace amount of radioactive ^{14}C-cholesterol. Lenses were incubated for various incubation times (1, 3, 7, 14, or 28 days), with three concentrations of lipid (0.5×, 1×, 2× tear film concentration) and with or without solution replenishment to assess each variable's impact on cholesterol deposition. After incubation, the lenses were extracted using 2:1 chloroform:methanol, extracts were analyzed in a beta counter and masses (micrograms per lens) were extrapolated from standard curves.

Results. Within the SiHy materials, balafilcon A deposited the greatest amount of cholesterol ($p < 0.001$) and lotrafilcon B the lowest ($p < 0.001$). The CH lens materials showed significantly lower uptake amounts than any of the SiHy lens materials ($p < 0.001$). The uptake of cholesterol ranged from 0.01 ± 0.01 μg/lens to 3.22 ± 0.34 μg/lens for all lens materials. Kinetic uptake of cholesterol was shown to be continuous throughout the 28 days of incubation without plateau ($p < 0.001$), and varying the lipid concentration did impact the resulting cholesterol deposition ($p < 0.001$). Replenishing the ATS every other day also affected cholesterol deposition throughout the experiment. Overall, the deposition pattern was 2× > replenishing > 1× > 0.5×.

Conclusions. Overall, SiHy lenses deposit significantly more cholesterol than CH lens materials, and the mass of lipid deposited is dependent on the contact lens material, length of incubation, concentration of lipids in the ATS, and the replenishment of ATS.

(Optom Vis Sci 2013;90:1057–1065)

Key Words: lipid deposition, silicone hydrogel contact lenses, kinetic uptake, cholesterol

The popularity of contact lenses has progressively increased[1,2] because of their convenience and ability to provide crisp clear vision. With the increasing demand for more comfortable and safer contact lenses, manufacturers have strived to develop new lens materials, which provide enhanced biocompatibility, higher oxygen transmissibility, and longer lasting comfort and wettability.[3–5]

First-generation soft contact lens materials, which were based on poly(hydroxyethylmethacrylate) (polyHEMA), were relatively comfortable but produced hypoxic complications during long periods of wear, especially when worn on an overnight basis.[6,7] During the past decade, silicone hydrogel (SiHy) contact lenses have become the predominant material of choice for contact lens wearers[2] primarily because of their high oxygen transmissibility.[8–10] However, SiHy lenses are not without their disadvantages, as the presence of siloxane groups within these materials results in relatively hydrophobic surfaces that impact wettability[11–13] and may also result in increased deposition of certain lipid species.[14–19]

To date, very few studies have systematically investigated the factors that may influence lipid deposition on contact lenses. Relevant factors to consider include the lipid concentration of the tear film, length of lens wear, influence of the contact lens material, and interactions between various tear film components.[17,19–22] The purpose of this study was to examine the *in vitro* uptake of a commonly deposited tear film lipid (cholesterol) onto polyHEMA-based conventional hydrogel (CH) and SiHy lens materials using a radiochemical method and a complex artificial tear solution (ATS)

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