

CHAPTER II.5.18

Medical Applications of Silicones

QUESTIONS

1. Which material property was the basis for Charles Holter's selection of silicone rubber for the hydrocephalic shunt valve?
 - a. biostability
 - b. hemocompatibility
 - c. thermal stability
 - d. viscoelasticity
 - e. all of the above.
2. Silicone breast implants cause which of the following complications?
 - a. breast cancer
 - b. connective-tissue disease
 - c. autoimmune disease
 - d. all of the above
 - e. none of the above.
3. Among the following applications where silicones are still in use today, which was the first reported human implantation of a silicone elastomer medical device?
 - a. breast augmentation
 - b. bile duct repair
 - c. hydrocephalus shunt
 - d. urethra repair.
4. Why are silicone hydrogel contact lenses approved for longer wear than conventional soft lenses?
5. Why were silicone materials originally applied to needles and syringes?

ANSWERS

1. The most correct answer is (c). While hemocompatibility, biostability and viscoelastic properties are all related to silicone's successful application in shunts for the treatment of hydrocephalus, thermal stability was the basis for Holter to select silicone rubber for his valve.
2. The correct answer is (e). Women with silicone breast implants have been the subject of numerous epidemiology studies conducted by prestigious researchers. Over 30 studies have examined the speculative link between implants and connective-tissue autoimmune diseases. The outcome of the research has been remarkably uniform, and concludes there is no causal association. More than ten studies have been published regarding implants and breast cancer. These studies consistently found no association between breast implants and increased risk of breast cancer.

More information regarding this topic can be found in the informative report "Safety of Silicone Breast Implants" from The (US) National Academies' Institute of Medicine, available at <http://www.nap.edu/books/0309065321/html/>.

3. The correct answer is (b). While many believe that Holter's silicone hydrocephalic shunts in 1956 were the earliest use, the first reported human implantation of a silicone elastomer medical device was actually a decade before. In April 1946, Dr. Frank Lahey used silicone elastomer materials from the experimental laboratory of General Electric Company called "bouncing clay" for bile duct repair. Silicone materials continue to be used in each of these applications today. The vast majority of today's breast implants still have shells made of silicone elastomer. Silicone stents and T-tubes remain in use for biliary repair. Valved hydrocephalus shunts of silicone, including the popular Pudenz-Schulte and Holter types, continue to save lives. Silicone tubes and catheters continue to find wide urologic use, including in the surgical repair of epispadias and hypospadias.
4. The major advantage of silicone hydrogel contact lenses is the high permeability of the material to gases, e.g., allowing adequate oxygen to reach the cornea. Conventional soft (hydrophilic) lenses rely mostly on the water they contain for their oxygen permeability. In general, the higher the water content of those lenses, the higher the oxygen permeability. However, even with very high water content, conventional soft contact lenses still have insufficient oxygen permeability for long-term continuous wear. Silicone provides for higher oxygen permeability than even water in contact lens formulations. Increasing the silicone while decreasing the water content in silicone hydrogel formulations actually increases the oxygen permeability, which allowed many patients to wear silicone hydrogel contact lenses continuously for prolonged periods in clinical studies. FDA approval for up to 30 continuous nights of wear resulted.
5. Silicone materials were originally applied to delay clotting of blood being delivered or sampled by the syringe. Soon, the ability of the silicone to lubricate the syringe barrel (for easier plunger operation) and the needle (for less pain) were recognized.