

Buffer Solutions in Ocular Irrigation

A chemically-burned eye should be irrigated until the pH returns to neutral. This may require two to three hours of continuous irrigation, so tolerability of the solution becomes a major issue. An ideal irrigating solution would be one that is well-tolerated by the patient, has a high buffering capacity, a pH similar to that of the eye is relatively inexpensive, and is readily available in an emergency situation. MorTan recommends lactated Ringer's as a solution that meets all the criteria.

For References and Additional Information visit:
www.morganlens.com

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What is a buffer?

A buffer solution generally refers to a liquid that shows a very small change in pH even when a strong acid or base is added. In other words, the buffer is able to maintain its pH regardless of whether you add either an acid or a base. Buffers are made by combining certain weak acids or weak bases with their salts.

How does a buffer work?

By one definition, an acid is a solution that breaks apart (dissociates) to form positive hydrogen ions (H^+), and bases dissociate to form hydroxide ions (OH^-). Both of these can break the chemical bonds found in other compounds, thus destroying (or denaturing) them. The strength of an acid or base depends on how easily it dissociates--the stronger ones break up more readily, producing more free ions.

Buffer solutions are able to chemically combine with these ions (*either* H^+ or OH^- ions), resulting in fewer free ions in the solution.

Why are buffers better for eye irrigation?

In addition to removing the contaminant, the goal of eye irrigation is to quickly return the pH to normal (about 7.1). A buffer solution is able to do this faster than a non-buffering one. Until the pH returns to normal, damage to the eye may continue.

Isn't eye irrigation all about dilution?

Dilution is critical--the relatively small amount of the chemical present in the eye will be diluted and/or washed out by the large quantity of irrigating solution. However, until the pH returns to normal, the caustic can continue to cause damage. A suitable buffer solution will both neutralize and dilute.

Is Normal Saline a buffer?

No. Normal Saline is formed by combining a salt (NaCl) with purified water. Since it has no buffering capability, it irrigates only by dilution. Also, some brands of NS have a pH as low as 4.5, causing considerable discomfort during irrigation.

"Benchtop" studies done by MorTan found that it took nearly twice as much Normal Saline as lactated Ringer's to neutralize either a strong acid or a strong base.

Not all buffers are created equal. Different solutions can maintain a pH at different levels.

Acid:
pH less than 7.0

Base (alkali):
pH greater than 7.0

Both acids and bases are known as "caustics"

Acids should NEVER be neutralized with an alkali and vice-versa. Exothermic reactions or the production of a precipitate or gas may result, causing additional damage. Some reactions can generate considerable heat when mixed with water (or tears) causing thermal burns.

Why does MorTan recommend irrigation with lactated Ringer's?

Lactated Ringer's (LR) Irrigation solution (very similar to Hartmann's solution and also called Ringer's lactate) is a buffering solution with a pH similar to that of the eye. Human tears have a pH of 6.5 to 7.6 (and an average of 7.1) while the pH of LR varies from 6.0 to 7.5 (depending on the manufacturer). Studies have shown that LR is more comfortable for the patient, especially when used with the Morgan Lens.

