

Ocular Irrigation Solutions

It is universally accepted that prompt and prolonged irrigation is the best treatment for ocular chemical burns, but what is the best irrigating solution? Time is of the essence, so initial irrigation should be done with any safe fluid. Water should not, however, be used for prolonged irrigation as it has been shown to be hypotonic to ocular tissues.

The use of high pH solutions (bases) to treat low pH (acid) burns, or vice-versa, is not recommended. There is a chance that an exothermic (heat-producing) chemical reaction, or one that produces a precipitate, may occur within the eye. Also, there should be no delay in starting irrigation in order to determine the caustic.

A chemically burned eye should be irrigated until the pH returns to neutral. This may require two to three hours of continuous irrigation, so the tolerability of the solution becomes a major concern.

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

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Patient tolerability to an irrigating solution allows for the prolonged irrigation necessary to properly treat ocular chemical burns.

Lactated Ringer's (LR)

MorTan recommends using **lactated Ringer's solution (Hartmann's solution) for ocular irrigation, as it is the closest to an ideal irrigating solution available.** In a recent study, LR when used with the Morgan lens was shown to be the most well-tolerated solution. The lactate ion appears to provide some buffering capacity, as shown by laboratory tests by MorTan (approximately half the amount of LR was required to neutralize NaOH as compared to NS). The combination of good tolerability, especially when used with the Morgan Lens, low cost, availability, and pH, make LR the best choice for ocular irrigation.

Balanced Salt Solution (BSS)

BSS was initially developed to provide ophthalmic surgeons with a solutions that would not damage intraocular tissues either structurally or functionally. The composition is very similar to the aqueous and vitreous humor and therefore is well tolerated. However, BSS must be reconstituted before use and is expensive, with a 500 ml bottle of BSS Plus retailing for over \$100.

Normal Saline (NS)

Although possibly the most commonly used solution, *many* studies have shown that NS is difficult for some patients to tolerate--75% of participants in one study. Studies from the late 1950's and early 60's showed that NS was toxic to intraocular tissues. This may be due in part to its low pH (ranging from 4.5 to 7.0 depending on the manufacturer) or its balance of electrolytes.

In a recent study of solutions on actual chemical burns, three of eleven patients were unable to tolerate NS or NS with bicarbonate. Another study found that 46% of volunteers complained of a burning sensation with NS--even though only 30 ml of solution was used.

The ideal solution is:

- Well tolerated
- Inexpensive
- Readily available
- High buffering
- Similar to tears in pH

Normal Saline with sodium bicarbonate

Sodium bicarbonate has been added to raise the pH of NS. Studies have shown these solutions to be irritating to many patients, providing additional evidence that it is not just the pH that makes the solution hard to tolerate.

Acid:
pH less than 7.0

Base (alkali):
pH greater than 7.0

Both acids and bases are known as "caustics"

Studies show using warmed solutions may increase tolerability

Acids should NOT be neutralized with alkalis and vice-versa. An exothermic reaction or the production of a precipitate or a gaseous product may cause additional damage.

pH comparison:
 lactated Ringer's: 6.0 to 7.5
 Normal Saline: 4.5 to 7.0
 Tap Water: 5 to 8
 Human tears: about 7.1

Hydrofluoric acid burns may be irrigated with a 1% calcium gluconate solution (10cc calcium gluconate 10% per 100cc normal saline)