

Solutions:

1. In the highly acidic environment of the stomach, the pH is below the pKa of the carboxylic acid, so that group is protonated. The aspirin is uncharged and not very soluble. When the pH is brought up by the gastric lavage (pH 8.5), the carboxylic acid, deprotonates. The aspirin is now charged and much more soluble. Therefore, it can be removed by the charcoal.
2. Hyperventilation would increase the exchange rate of CO₂ and O₂, thereby decreasing the partial pressure of CO₂ and increasing the partial pressure of O₂ in the bloodstream. Decreased CO₂ could result in alkalosis. CO₂ is proportional to the amount of carbonic acid in the bloodstream. In other words, during hyperventilation, CO₂ is blown off, so the amount of acid in the bloodstream decreases, leading to an increase in pH.

$$3. \text{ pH} = \text{pK}_a + \log \frac{[\text{HCO}_3^-]}{[\text{H}_2\text{CO}_3]} \quad 7.75 = 6.1 + \log \frac{[\text{HCO}_3^-]}{[\text{H}_2\text{CO}_3]}$$
$$\frac{[\text{HCO}_3^-]}{[\text{H}_2\text{CO}_3]} = 44.7$$

Thus, the ratio of conjugate base to conjugate acid is much higher than the normal value of 20 in this patient. The patient has too much bicarbonate and not enough carbonic acid. Thus, the blood cannot effectively buffer against the addition of a base because there is not enough of the acid.