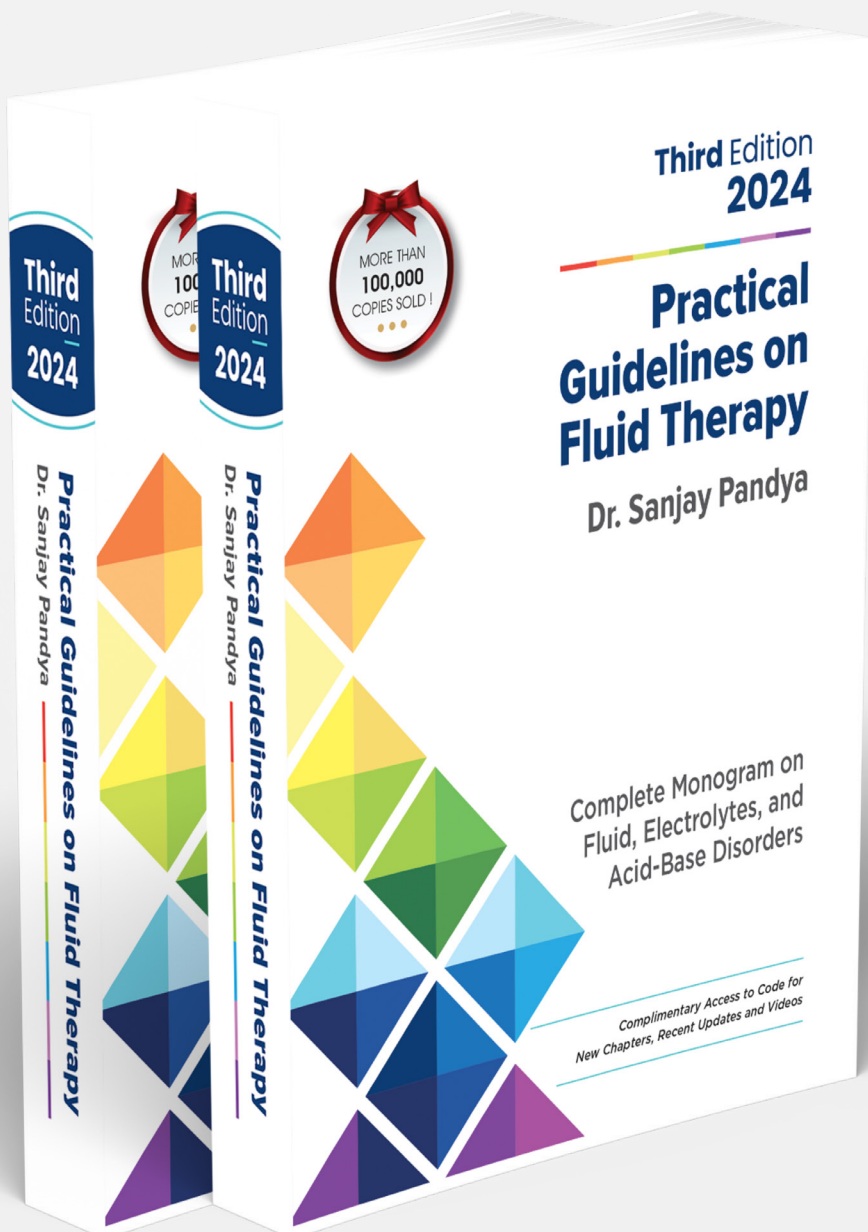




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## Chapter 33:

## Respiratory Acid-Base Disorders



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# 33

## Respiratory Acid-Base Disorders

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Respiratory acidosis and respiratory alkalosis are the two primary respiratory acid-base disorders commonly encountered in clinical practice, both resulting from primary changes in  $p\text{CO}_2$  due to various disorders.

### RESPIRATORY ACIDOSIS

#### DEFINITION AND BASIC UNDERSTANDING

Respiratory acidosis, also known as primary hypercapnia, is a clinical disorder characterized by a primary elevation in the  $\text{PaCO}_2$  ( $>45$  mmHg) leading to a reduction in pH ( $<7.35$ ) and variable compensatory increase in the plasma

$\text{HCO}_3^-$  concentration.

Respiratory acidosis occurs when the effective alveolar ventilation ( $\text{CO}_2$  excretion by the lung) fails to keep pace with the rate of  $\text{CO}_2$  production. Acute respiratory acidosis occurs rapidly within  $<48$  hours, while chronic respiratory acidosis develops slowly over days to weeks ( $>48$  hours).

#### Renal compensation

Respiratory acidosis leads to renal compensation through increased urinary  $\text{H}^+$  secretion, resulting in acidic urine. This gradual process leads to a rise in plasma  $\text{HCO}_3^-$  levels, mitigating acidosis. Because renal compensation is a slow process, the compensatory increase in  $\text{HCO}_3^-$  is

small in acute respiratory acidosis. In contrast, in chronic respiratory acidosis, the compensatory rise in  $\text{HCO}_3$  is more substantial over time due to robust and prolonged renal compensation.

**Acute respiratory acidosis:** Every 10 mm of Hg rise in  $\text{PaCO}_2$  causes 1 mEq/L rise in  $\text{HCO}_3$  and 0.1 fall in pH.

**Chronic respiratory acidosis:** Every 10 mm Hg rise in  $\text{PaCO}_2$  causes a 4 mEq/L rise in  $\text{HCO}_3$  and a 0.03 fall in pH.

Serum  $\text{HCO}_3$  usually does not exceed 38 mEq/L due to compensation. If  $\text{HCO}_3$  is  $>38$  mEq/L, think of concomitant metabolic alkalosis.

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### REFERENCES

1. Sarkar M, Niranjana N, Banyal PK. Mechanisms of hypoxemia. *Lung India*. 2017;34(1):47–60.
2. Palmer BF, Clegg DJ. Respiratory Acidosis and Respiratory Alkalosis: Core Curriculum 2023. *Am J Kidney Dis*. 2023;82(3):347–359.
3. Adrogue HJ, Madias NE. Management of Life-Threatening Acid–Base Disorders. *N Engl J Med*. 1998;338(1):26–34.
4. Boatright JE, Jensen MQ. Therapeutic Gases: Management and Administration. In: Hess DR, MacIntyre NR, Galvin WF, editors. *Respiratory Care: Principles and Practice*, 4th edition. Jones & Bartlett Learning, LLC, an Ascend Learning Company; 2021. Chapter 14, pages 285–320.
5. Theerawit P, Soipetkasem P. An importance of respiratory drive and effort during mechanical ventilation: Respiratory drive and effort in respiratory failure. *Clin Crit Care [Internet]*. 2023;31(1):2023:e0001.
6. Rocker G. Harms of over oxygenation in patients with exacerbation of chronic obstructive pulmonary disease. *CMAJ*. 2017;189(22):E762–E763.
7. Sarkar M, Madabhavi I, Kadakol N. Oxygen-induced hypercapnia: physiological mechanisms and clinical implications. *Monaldi Arch Chest Dis*. 2023;93(3):2399.
8. O’Driscoll BR, Howard LS, Earis J, et al. BTS guideline for oxygen use in adults in healthcare and emergency settings. *Thorax* 2017;72(Suppl 1):iii1–iii90.
9. Echevarria C, Steer J, Wason J, et al. Oxygen therapy and inpatient mortality in COPD exacerbation. *Emerg Med J*. 2021;38(3):170–7.
10. Barnett A, Beasley R, Buchan C, et al. Thoracic Society of Australia and New Zealand Position Statement on Acute Oxygen Use in Adults: ‘Swimming between the flags’. *Respirology*. 2022;27(4):262–276.
11. Fujishima S. Guideline-based management of acute respiratory failure and acute respiratory distress syndrome. *J Intensive Care*. 2023;11(1):10.
12. Austin MA, Wills KE, Blizzard L, et al. Effect of high flow oxygen on mortality in chronic obstructive pulmonary disease patients in prehospital setting: randomized controlled trial. *BMJ* 2010;341:c5462.
13. Adrogue HJ, Madias NE. Alkali Therapy for Respiratory Acidosis: A Medical Controversy. *Am J Kidney Dis*. 2020;75(2):265–271.
14. Chand R, Swenson ER, Goldfarb DS. Sodium bicarbonate therapy for acute respiratory acidosis. *Curr Opin Nephrol Hypertens*. 2021;30(2):223–230.
15. Quade BN, Parker MD, Occhipinti R. The therapeutic importance of acid-base balance. *Biochem Pharmacol*. 2021;183:114278.
16. Sanghavi S, Albert TJ, Swenson ER. ACID-BASE BALANCE. In: Broaddus VC, Ernst JD, King TE Jr, editors. *Murray & Nadel’s Textbook of Respiratory*

- Medicine. Seventh Edition. Elsevier - Health Sciences Division; 2021. Chapter 12, page 166.
17. Laffey JG, Kavanagh BP. Hypocapnia. *N Engl J Med.* 2002;347(1):43–53.
  18. Mazzara JT, Ayres SM, Grace WJ. Extreme hypocapnia in the critically ill patient. *Am J Med.* 1974;56(4):450–6.
  19. Foster GT, Varizi ND, Sassoon CS. Respiratory alkalosis. *Respir Care.* 2001;46(4):384–91.
  20. Callahan M. Hypoxic hazards of traditional paper bag rebreathing in hyperventilating patients. *Ann Emerg Med* 1989;18(6):622–8.
  21. Bartscher M, Gatterer H, Faulhaber M, et al. Acetazolamide pre-treatment before ascending to high altitudes: when to start? *Int J Clin Exp Med.* 2014;7(11):4378–83.

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