anism and is probably evident to some degree in all patients who manifest hypoxemia.

### Diffusion Defects

A *diffusion defect* is an anatomic impedance to oxygen transfer in the lungs, due to a thickened alveolar-capillary membrane. However, it is unlikely that diffusion defects alone result in hypoxemia at sea level in humans with normal cardiac output. Most of the hypoxemia at rest observed in patients with diffusion defects is believed to be mainly a result of concurrent relative shunting.[128] These patients may, however, manifest hypoxemia during exercise, which may facilitate their diagnosis.

In any event, hypoxemia associated with diffusion defects responds to oxygen therapy. Thus, for clinical purposes, it is reasonable to include these patients under the category of relative shunting.

### Summary

Methods for differentiation of the four mechanisms of hypoxemia have been discussed. Application of $P(A - a)O_2$ in making the differential diagnosis has also been presented. The role of $P(A - a)O_2$ in the differential diagnosis of hypoxemia is summarized in Table 9–3. Limitations of the $P(A - a)O_2$ have also been discussed. The purpose of the differential diagnosis is to enhance our understanding of the pathologic mechanisms that predominate in a given patient, which, in turn, should assist us in the development of a good therapeutic plan.

**Table 9–4.** SIGNS AND SYMPTOMS OF HYPOXEMIA AND HYPERCAPNIA*

| |
|---|
| Hypoxemia |
| Muscular incoordination |
| Confusion |
| Loss of judgment |
| Extreme restlessness, combative behavior |
| Tachycardia |
| Mild hypertension |
| Peripheral vasoconstriction |
| Cyanosis |
| Bradycardia† |
| Bradyarrhythmias† |
| Hypotension† |
| Hypercapnia |
| Progressive somnolence |
| Disorientation |
| Mucosal, scleral, conjunctival hyperemia |
| Diaphoresis |
| Tachycardia |
| Hypertension |

From Glauser F. L., Polatty R. C., and Sessler C. N.: Worsening oxygenation in the mechanically ventilated patient. Am. Rev. Resp. Dis., *138*:458–465, 1988.
† Associated with severe hypoxemia.

## CLINICAL APPEARANCE OF THE PATIENT WITH HYPOXEMIA/HYPERCAPNIA

The clinical appearance of the patient may be the first clue with regard to the onset or worsening of hypoxemia or hypercapnia. Some of the most important signs and symptoms commonly associated with hypoxemia or hypercapnia are shown in Table 9–4. Sometimes the hypoxemic patient is relatively asymp-

**Table 9–3.** DIFFERENTIAL DIAGNOSIS OF HYPOXEMIA*

| Abnormality | Arterial $P_{O_2}$ | Arterial $P_{CO_2}$ | Alveolar-Arterial $P_{O_2}$ Difference | |
|---|---|---|---|---|
| | | | *Room Air* | *100% $O_2$* |
| Hypoventilation | Decreased | Increased | Normal | Normal |
| Absolute shunt | Decreased | Normal or decreased† | Increased | Increased |
| Relative shunt | Decreased | Normal, increased, or decreased† | Increased | Normal |
| Diffusion defect | Normal at rest<br>Decreased during exercise | Normal or decreased† | Normal at rest<br>Increased during exercise | Normal |

* From Hinshaw, H. C., Murray, J. F.: Diseases of the Chest, 4th ed. Philadelphia, W. B. Saunders Company, 1980, p. 960.
† Attributable to hyperventilation from secondary causes.