Instructor's Response(s) to Discussion Question(s) - Module 11

Briefly explain/discuss the likely short-term (i.e., within a few hours) effect(s) of a small (≤ 10 mm^2 in area) tear or puncture in the pleural membrane of one (but not the other) lung on respiratory function. Please **post your response by 9:00 PM on Day 4 of the Module**.

Recall that each lung is contained within its own pleural sac (see VSL[14], section 13.2 and Figure 13.5). During inspiration the volume of the thorax (chest cavity) increases (B&L[6+], Figure 20-12; B&L[7], Figure 20.10; West[10], pages 109 - 110); this increase in volume also increases, or at least tries to increase, the volume of the pleural space (the parietal pleura is adherent to the inner surface of the chest wall; the visceral pleura adheres to the outer surface of the lung). The pleural sac is a closed volume; if it expands the pressure in it will drop. The reduced intrapleural pressure results in an increase in transpulmonary pressure (B&L[6+], Figure 21-8; B&L[7], Figure 21.7), which leads to an expansion of the lung, which reduces intra-alveolar pressure which, finally, allows atmospheric air to enter the lung down a pressure gradient (B&L[6+], Figure 21-9; B&L [7], Figure 21.2).

So - a tear or puncture of a pleural sac means that the pleural space pressure will not decrease when the thoracic cavity volume increases[1], so that the lung will not increase in volume; in fact, the lung volume will decrease because of elastic recoil (see VSL[14], Figure 13.11; West[10], Figure 7.10). So - the lung in the pleural sac with the tear/puncture will not be ventilated and so will not contribute to gas exchange. The remaining lung will continue to function and, absent pathology, the individual will be able to breathe, but will likely need to breathe more deeply and/or faster.

For those who are clinically inclined, if air (rather than fluid) enters the pleural sac the situation described is referred to as a pneumothorax - see VSL[14], Figure 13.11; West[10] Figure 7.10; B&L[7], page 435.

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[1] If there is a tear/puncture in the pleural sac it is no longer a closed space; the pressure in the pleural space will not change with expansion of the chest cavity.

Rev 0, adapted from Fall 2016
Rev 1, 11/5/17 - up-dated references to include B&L[7], West[10]
Rev 2, 11/14/17 - revised 2nd paragraph of response and footnote
Rev 3, 7/16/18 - up-date to 601; revise for consistency with Rev 3 of DQ11
Rev 4, 11/4/19 - change area of hole and time due for consistency with Rev 4 of DQ11