AIR SACS

Associated with the lungs are characteristic, bladder like distensible air sacs. They are formed due to the expansion of the mucous membrane of the secondary bronchi except for the abdominal air sac that arises from the posterior end of the mesobronchus. They have a wall consisting of a double epithelium, i.e., the inner mucous membrane and the outer peritoneum and between the two is the supporting connective tissue. In pigeon, there are 9 air sacs, 4 paired and one median. They are as follows:

1. Interclavicular Air Sac : It is a single median and somewhat triangular air sac. It is situated between the two limbs of furcula. On either side, it gives off an extra-clavicular sac in the arm pit,which communicates with the air cavity of the humerus and a clavicular sac.
2. Cervical Air Sacs : A pair of cervical air sacs arise anteriorly, one from each lung. They lie at the base of the lung dorsal to the interclavicular and along the sides of the vertebral column. They give off minor saccules in the neck.
3. Anterior Thoracic Air Sacs : A pair of anterior thoracic air sacs lie in the anterior part of the thorax in close contact with the ribs and the pericardium.
4. Posterior Thoracic Air Sacs : A pair of small posterior thoracic air sacs lie in the posterior part of the thorax just in front of the abdominal air sacs. Each sac overlaps the posterior end of its lung.
5. Abdominal Air Sacs : A large abdominal air sac arises from the posterior angle of each lung. They lie along the dorsal wall of the abdomen, ventral to the kidneys, amongst the coils of the small intestines.

   All these air sacs communicate with the pneumatic cavities of the bones on one hand and with the secondary bronchi on the other hand. Except for the cervical air sacs, all other air sacs, even the abdominal air sacs rejoin the secondary

bronchi through the recurrent bronchi. These recurrent bronchi arise from the proximal ends of the air sacs.

The air sacs, being poorly vascular and receiving oxygenated blood play no role in gaseous exchange but they increase the efficiency of the lungs by providing them fresh air even during expiration. This is evident from the mechanism of respiration occurring in the bird at rest and during flight which is as follows:

At Rest: A resting bird lowers and raises the ribs and sternum alternately, by the action of the intercostal muscles. The lowering of the sternum and ribs enlarges the thoracic region of the body cavity, creating a negative pressure in it. This causes the fresh air to be sucked through the respiratory tract into the lungs. Some of the incoming fresh air passes directly into the air sacs, which expand, and some goes into the air-capillaries, where exchange of gases takes place. Rising of the sternum and ribs reduces the body cavity and causes the pressure over the air sacs. This pressure forces the air from the air sacs into the air capillaries where the exchange of gases takes place and then the air (de-oxygenated) passes out through the respiratory tract to the exterior.

So, it must be noted that the air capillaries receive fresh air both during inspiration and expiration (during expiration from air sacs). Whole of the air in the air capillaries is changed, leaving no residual air in them. As a result of this, the aeration of blood is complete and this is responsible for the high metabolic activity and temperature of the birds.

During flight : During flight, the movement of air in the air sacs is brought about by the pressure from the surrounding viscera and by movements of the flight muscles and hollow wing bones which have extensions of the air sacs. At this time, the skeleton is kept rigid to strengthen the wings, and the mode of drawing

in and turning out air by using intercostal muscles is stopped temporarily. The faster a bird flies, the faster is the flow of air through the respiratory channels. The efficiency of this type of respiration is shown by the fact that the best flying birds have the most highly developed air sacs.

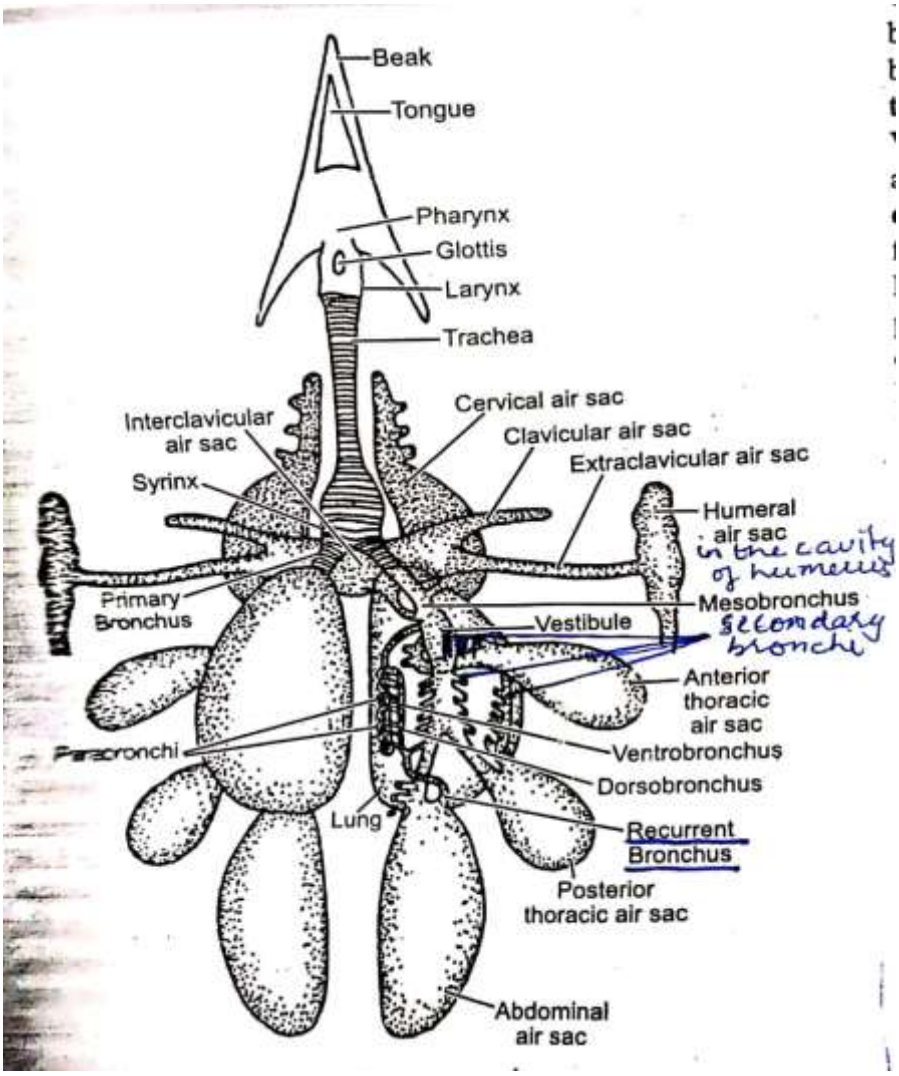

Diagram showing air sacs in birds (pigeon)