Non-respiratory Functions of the Lung

The non-respiratory functions of the lung have become a successful focus for research effort in recent years. Problems of air pollution have generated interest in the ability of the lung to overcome airborne invasions by foreign particles and, as a consequence, the various defense mechanisms against infective agents are becoming delineated. Identification of the role of surfactant in maintaining pulmonary integrity has resulted in a relatively massive effort directed at defining the normal and pathophysiologic consequences of lipid biosynthesis in the lung tissue.

The lung is the only organ to which all of the blood is exposed in a single circulation. Thus, the ability of the pulmonary circulatory bed to filter the blood stream has received renewed attention with the realization that in massive blood transfusions its efficiency in removing platelet aggregates, thrombi, and other debris may compromise its gas-exchanging properties. Other examples probably come to the reader’s mind. For the most part, the non-respiratory functions of the lung have become apparent as a result of investigating an initial abnormality of its respiratory functions. It, therefore, requires something of a mental somersault to consider normal functions for the lung that are quite independent of its respiratory role.

From a teleologic viewpoint, the pulmonary vascular tree is ideally situated to monitor and modify the composition of the circulating material. During the last decade, a number of investigators have shown that a variety of circulating compounds are cleared or otherwise modified by passage through the lung. The mechanisms that have been proposed to account for these effects include: 1) the action of enzymes within the blood (e.g., cholinesterase); 2) physical transfer to alveoli of volatile substances (e.g., anesthetics); 3) uptake by cells for storage, reuse, or degradation; and 4) the presence of endothelial surface enzymes capable of degrading or converting the compound to more or less active forms.

The paper by Gillis in this issue is concerned with the pulmonary activity of the last two of these mechanisms. He has summarized much of the work that has appeared concerning the effects of passage through the pulmonary circulation on drugs and naturally circulating agents. For the circulating vasomotor agents, he suggests a working hypothesis to explain the very selective nature of these effects. In essence, Gillis proposes that the lung removes substances that are released only for local tissue effects and allows free passage to those whose beneficial actions are of a general nature. Thus, norepinephrine is primarily a local tissue vasoconstrictor and is, therefore, bound and degraded during passage through the lung, while epinephrine has more general actions and hence passes unscathed through the pulmonary circulation and into the systemic arteries. By this mechanism the body's response to the products of individual tissue vasoactivity may be regulated.

There is ample evidence that the necessary enzymes are present in lung tissue, although some controversy exists as to their anatomic site. Electron microscopy has revealed villus-like processes lining the walls of pulmonary arteries and veins and, as in the capillaries, specific binding and enzyme sites have been proposed for these structures. Aldosterone
and ACTH are concentrated in the lung tissue following intravenous injection, and the possibility that the lung may play a part in the regulation of the circulatory level of such hormones has been entertained.

However, most of the work reviewed by Gillis concerns the role of the lung in regulating the plasma concentration of the vasoactive agents \(5\)-hydroxytryptamine (serotonin), bradykinin, angiotensin, and the prostaglandins. The evidence of the modifying effect of passage through the lung is convincing and its specificity remarkable. The hypothesis proposed is appealing and gives a nice "sense of order" to an otherwise very confusing field.

Of course there are problems, both the technical ones of identifying and determining differences in concentration of the minute quantities involved, as well as those of assessing the physiologic significance of these phenomena. A primary consideration has to be the difficulty of defining the importance of 5-hydroxytryptamine, kinins, and the prostaglandins in homeostasis and defense reactions. They are found in many tissues and have been implicated individually or in concert as regulators of normal tissue blood flow and of fluid and electrolyte balance, instigators of thrombosis, inflammatory and antigen-antibody reactions, and modulators of cerebral nervous system activity and endocrine effects as second messengers comparable to cyclic adenosine monophosphate.

While there is considerable confusion about the relative influence of each agent, there is little doubt that they are involved in generalized responses such as hemorrhagic, septic, and traumatic shock, and transplantation reactions. The paper by Gillis is the first to bring to the attention of anesthesiologists the possibility that the lung is a critically important part of the system regulating the level of circulating vasoactive substances. The concept is thought-provoking and exciting, and it is tempting to hypothesize pathophysiologic consequences of an interaction with anesthetic drugs and techniques. Future work along the line suggested by Gillis will be awaited with great interest.

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References

Obstetrics

FETAL ELECTROCARDIOGRAPHY Intrapartum fetal ECG monitoring was performed on 1,150 occasions with a transcervical intrauterine catheter. Endometritis was rare, and postpartum febrile morbidity could not be attributed directly to the techniques used. Three asymptomatic uterine perforations were encountered. Two of these were found incidentally at time of cesarean section; an additional suspected perforation was confirmed radiologically; but none was associated with additional complications. Fetal scalp abscesses or other major complications due to application of the electrodes were not seen. (Chan, W. H., Paul, R. H., and Tocci, J.: Intrapartum Fetal Monitoring—Maternal and Fetal Morbidity and Perinatal Mortality. Obstet. Gynecol. 41: 7-13, 1973.)