LECTURE 6.

Anatomy: Circulatory system

Circulatory system

Unlike the "closed" circulatory system of humans, insect circulatory systems are said to be "open", meaning that they lack a complex network of veins and arteries to help transport blood throughout the body. Instead, insect blood (called **hemolymph**) flows relatively "freely" throughout the hemocoel.

Figure 8-2. Circulatory system. Arrows indicate direction of flow of hemolymph.

Only one vessel is present in the insect circulatory system: the **dorsal vessel**. Posteriorly (in the abdominal region), the dorsal vessel acts as the **heart**, pumping hemolymph forward into the anterior region (in the head and thorax), where it acts as the **aorta** and dumps the hemolymph into the head. It flows posteriorly and is returned to the heart via **ostia**, which are small slits in the heart region of the dorsal vessel designed for hemolymph uptake.

To view the dorsal vessel, examine the "back" (or dorsal region) of the insect's body cavity for a very thin line that runs longitudinally from the head to the tip of the abdomen. Use the grasshopper or specimen that was ventrally dissected, as dorsal dissections will likely mutilate the vessel. Do not be discouraged if you have trouble finding it on your specimen. The dorsal vessel is very, very thin. Compare your specimen to those of your classmates.

Circulatory system in insects

Aorta portion of dorsal vessel

Heart portion of
dorsal vessel
Circulation in insects is maintained by a system of muscular pumps moving haemolymph
through compartments separated by fibromuscular septa or membranes. The main pump
is the pulsatile dorsal vessel. The anterior part may be called **aorta** and the posterior part
the **heart**. The dorsal vessel is a simple tube, generally composed of one layer of
myocardial cells and with segmentally arranged openings called **ostia**. The ostia permit
the one-way flow of haemolymph into the dorsal vessel due to valves that prevent
backflow. There may be up to three pairs of thoracic ostia and nine pairs of abdominal
ostia. The dorsal vessel lies in the **pericardial sinus**, a compartment above a dorsal
diaphragm (a fibromuscular septum - a separating membrane) formed of connective
tissue and segmental pairs of alary muscles. The alary muscles support the dorsal vessel
but their contractions do not affect heartbeat.
Haemolymph enters the periocardial sinus via segmental openings in the diaphragm and
then moves into the dorsal vessel via the ostia during a muscular relaxation phase. Waves
of contraction start at the posterior end of the body, pump the haemolymph forward in the
dorsal vessel and out via the aorta into the head. Next the appendages of the head and
thorax are supplied with haemolymph as it circulates posteroventrally and finally returns
to the pericardial sinus and dorsal vessel.
Another important component of the insect circulatory system is the **ventral diaphragm**,
a fibromuscular septum that lies in the floor of the body cavity associated

with the ventral
nerve cord. Circulation of the haemolymph is aided by active peristaltic contractions of
the ventral diaphragm which direct the haemolymph backwards and laterally in the
perineural sinus below the diaphragm. These movements are important in insects that
use the circulation in thermoregulation. Ventral diaphragm also facilitates rapid exchange
of chemicals between the ventral nerve cord and the haemolymph.
Haemolymph is generally circulated to appendages unidirectionaly by various tubes,
septa, valves and pumps. The muscular pumps are termed **accessory pulsatile organs**
and occur at the base of the antennae and legs. Antennal pulsatile organs releases
neurohormones that are carried to the antennal
lumen to influence the sensory neurones. Circulation occurs in the wings of young adult.
In wing circulation is sustained by influxes of air into the wing veins, rather than any
pulsatile organs. Pulses of air in the fine tracheal tubes of the veins push the haemolymph
through the enclosed space of the veins.
The insect circulatory system shows high degree of co-ordination between dorsal vessel,
fibro-muscular diaphragms and accessory pumps.

Sources

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