Oral Presentation (PCS-2)

Specialized Structured Cardiovascular of Bats Related to Their Ability to Fly

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INTODUCTION

Bats have the second largest diversity in mammalian classes after rodentia (Nurfitrianto et al., 2013). Bat population reaches approximately 1100 species (Teeling et.al 2005). In Indonesia there are 205 or 21% of known world bat species (Suyanto 2001). Bats are the only flying mammals. The ability bat to fly is supported by the shape of the extremities and also the adaptation of the cardiovascular organs. Based on empirical studies of cardiovascular was known that cardiac muscle mass is a good indicator for the degree of adaptive specialization of prolonged locomotor activity, in both birds and mammals. Data on cardiovascular muscle morphology and muscles that support flying ability will provide an overview of the behavior, ecology and physiology of certain animals (Bishop 1997).

Several studies have been conducted to study the cardiovascular system of bats. Research on bat hematology profile has been done (Heard and Whittier 1997, Mclaughlin *et.al* 2007, Wawrocka and Bartonicka 2014, McMichael *et al*. 2015, Ratnasooriya 2016, Rashid et al, 2016, Rahma *et al*., 2018). Joseph (1908) says that every animal has a different size and heart shape to each other. This heart size difference is influenced by the size of the body and the high energy required by the animal (Joseph 1908).

Bat's heart rate is known to increase during flight (Thomas and Suthers 1972). This is causes an increase in the rate of metabolism. Writing this paper will discuss about the uniqueness of the bat's heart so that it can support its ability to fly.

RESULT AND DISCUSSION

Metabolism and flight ability

Birds and bats are the only vetebrate that has the ability to fly. Phylogenetic differences make them perform elastic mode of motion with several methods. Integration of functional and structural parameters, used to overcome problems that are overcome during flight. Unique morphological, physiological and biochemical properties are enhanced to enhance oxygen uptake, transfer, and utilization for high aerobic activity (Maina 2000). Birds are known to have higher metabolic rates than terrestrial mammals that have the same body size to perform an exercise (Thomas and Suthers 1972). Based on this growing research to determine the energy needed by bats during flying and try to see the adaptations possessed by these mammals to be able to maintain a high metabolism as well as in birds. Genetic comparisons of different mammalian species show that bats have highly modified gene versions, especially those responsible for converting food into energy (*Shen et al.,* 2010).

The high rate of metabolism in bats is also related to the frequency of the heart. Rapid contractions will require an increase in ATP and cause increased metabolism, therefore bats require 3 to 5 times the energy required by terrestrial mammals (Thomas and Suthers 1972, Maina 2000).

Bats cardiovacular

The bat's heart (*R. aegyptiacus*) is known oval and the color is dark red (Alijani and Ghassemi 2016). The size of the bat's heart (*Tadarida brasiliensis*, *Mormopterus kalinowski*, *Myotis chiloensis*, *Histiotus macrotus*, *H monatnus*, *Lasiurus borealis*, and *L.linereus*) were found to be larger than those of other mammals or of bats having larger body sizes than bats (Canals et al 2005). The relative mass of the bat's heart is known to decrease in proportion to the increase in body mass, which is $Mb^{-0.21}$ (Canals et al 2005). This is related to the high energy required when flying.

Bat's heart is also known to have a heart-weight ratio: greater weight than the other terrestrial mammal mammals, but smaller when compared to birds (Joseph 1908). This proves that the activity performed by an individual can affect the size of the heart.

Bats respiration

The aerobic capacity of a bat at the time of flight is essentially the same as that of a bird at the

time of flapping but compared with a non-flying mammal its velocity increases 2.5-3 times (Thomas and Suthers 1972). According to Thomas and Suthers 1972 bats increase its VO 20-30 times than before flying. Speed of oxygen consumption during flight of 4-8.6m / s (Carpenter 1985). Based on research conducted by Maina and King (1983), it is known that bats have a very high lung volume when compared with birds or other terrestrial animals. While the capillary volume in the lung bats is similar to that of birds, it is larger than other mammals (Maina and King 1983).

CONCLUSION

The bat's respiration increases during flight, so the bat can meet its oxygen consumption. This causes the bats to have a higher metabolic rate compared to other terrestrial mammals. The high rate of metabolism is supported by the heart's ability to pump blood more rapidly, so bats have a heart-to-weight ratio greater than that of non-flying mammals.

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