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Standard pulse contour methods are not applicable in animals

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Sir: I read the paper of Gunn and colleagues [1] evaluating the pulse contour method in animals with great interest, yet also with growing disappointment. This although the authors show great skill in performing animal experiments. Being closely associated with the development of pulse contour methods, I was alarmed by the third paragraph in their introduction. They state that the original Wesseling algorithm [2] was implemented in the PiCCO software version 1.0.14 (Pulsion, Munich, Germany) used in this study. Next they describe the characteristics of the modelflow pulse contour method which indeed was the topic of the cited paper. This citation is wrong and tendentious, because the authors implicitly try to convince the readers that the conclusions of their paper also count for the modelflow method.

The software version 1.0.14 is derived from Wesseling's cZ pulse contour method as has been mentioned by Pulsion. This method derives beat-to-beat stroke volume (SV) by dividing the area under the systolic part of the pressure curve by the characteristic impedance (cZ). The cZ method was published by Wesseling and colleagues [3] in 1976 and implemented on an analog computer by Philips (model MM200, Eindhoven, the Netherlands). The implementation on a digital IBM-8086 was described in 1990 [4] and was tested also at the University of Munich.

In contrast to the cZ method, the modelflow method first computes real-time outflow of blood from the left ventricle into the arterial vascular bed, with use of a non-linear three-element model, and next derives SV by integration of the area under the flow curve. These two approaches are principally different and lead to different results. Therefore, the citation should be changed to [3, 4].

Even more important, the authors have fallen into a trap with open eyes. The cZ method corrects for the non-linear behaviour of the arterial vascular bed and for pressure reflections from the periphery. These corrections for the characteristic impedance are derived from measurements on human aortas, as was mentioned in the original paper [3, 4]. The misuse of the cZ or PiCCO method by the authors can be observed easily in Fig. 1, where the compliance of the thoracic aorta (C) of 16 humans, 10 pigs and 6 dogs is plotted versus the applied arterial pressure (P). Clearly there are differences in aortic compliance between humans, pigs and dogs. Furthermore, for humans the pressure versus compliance relation is age dependent [5]. For animals, however, this relation has not been studied.

In short, the authors should have used a cZ or PiCCO method based on the properties of the arterial vascular bed of the dog to perform a fair comparison between SV by pulse contour and SV by an ultrasound flow probe.

Similar remarks can be made with respect to the use of the Deltex CardioQsystem, which processes Doppler velocity to blood flow in the thoracic aorta. As the measurement site with this probe is different from the site of the ultrasound flow probe the results must be different. The formula used to convert thoracic aortic blood flow to outflow of the left ventricle might be different for different species.

In the paper presented it is as if the authors use a plane as a boat to cross the ocean (they used a human evidence-based method for animal research). I must strongly advise them not to do so.

In conclusion: The authors should withdraw the paper in its present form to protect the readers of ICM against misleading information and conclusions.

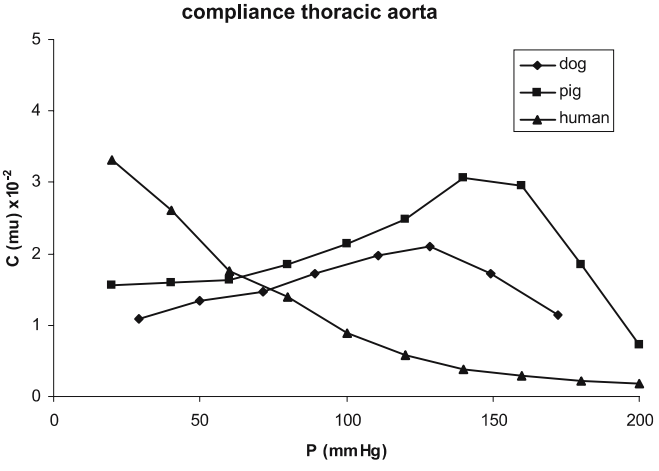

Fig. 1 Compliance per unit length of the descending thoracic aorta as a function of pressure in three different species. Data from Langewouters, method described in [5]

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