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Real-time tomographic images for organ function monitoring and diagnosis

eit inside ® electrical impedance tomography

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HYPERTONIC SALINE INJECTION TO DETECT AORTA IN PORCINE EIT

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INTRODUCTION Automated assessment of hemodynamically functional structures, such as the aorta, by electrical impedance tomography (EIT) is still a major challenge. While physiological parameters like the pulse arrival time (PAT) or local conductivity characteristics [1] seem to be suitable for this task, a reliable identification of the aorta is necessary first. We propose here methods in the time and space domain to detect aortic EIT-pixels in response to an injection of a hypertonic saline bolus into the aortic arch.

METHODS A hypertonic saline bolus (10ml, 20% NaCl) was injected into the aortic arch of 6 anesthetized pigs (Ethics approval No.53/11) during ceased ventilation and applied EIT (Swisstom BB^2) at T9/10. EIT images were reconstructed using GREIT [2], utilizing individual thorax contours from segmented computed tomography (CT) images. The resulting time-dependent image $\mathbf{X}(t)$ in $\mathbb{R}^{64x64}$ was low-pass filtered (f<0.8Hz) and analyzed in each pixel x_{ij} after the bolus injection. The aortic peak in $\mathbf{X}(t)$ and its prominence was calculated from local maximum and neighboring minima of x_{ij}, respectively (Fig. 1b). The spatial maximum of the resulting time-independent matrix was defined as aortic pixel p_A (Fig. 1a).

RESULTS AND CONCLUSIONS Sharp profiles around p_A were observed in all pigs and were closely located to the anatomical aorta (with distance of 5±3 px from the true aorta location). A complete overlap of p_A and aorta from CT can be hardly expected because of limitations in EIT reconstruction. In addition, estimated PAT at p_A was in the range of 102±14ms in contrast to p_H and p_L (Fig. 1c).

The present work evaluates temporal conductivity modulation in EIT after injection of a hypertonic bolus with the final goal to assess hemodynamics and position of aortic region.

IMAGE

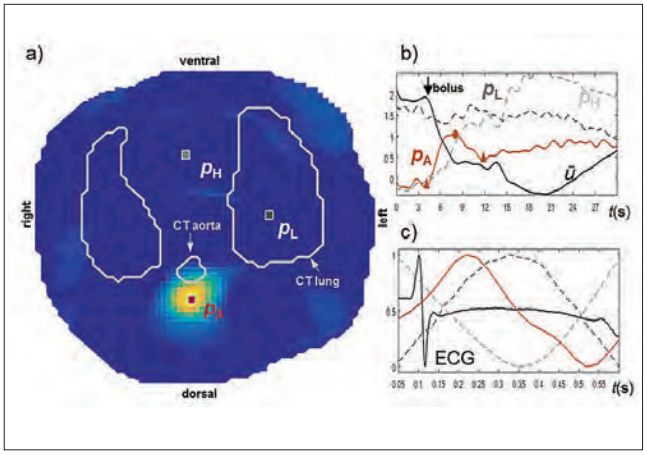

Figure 1: *a) Detection of aortic pixel p_A in EIT with anatomical contours from CT. b) Selected pixels x_{ij} and the average voltage $\bar{u}$. c) Averaged cardiac components and ECG.*

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