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01) A Comparative Study of Methods for Cardiac Ventricular Volume Estimation

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PURPOSE

Accurate and automatic estimation of cardiac ventricular volumes, e.g., left ventricle (LV) and right ventricle (RV), is of great significance for clinical assessment of cardiac functions. Existing estimation methods can be categorized into conventional contouring-based methods and emerging direct estimation without contouring. This study comparatively investigates representative methods from each category to find out the more suitable one for cardiac ventricular volume estimation in clinical use.

METHOD AND MATERIALS

3360 2D short-axis cine MR images from 56 clinical subjects were used. Each contains 20 frames in a cardiac cycle. These images were acquired on a 1.5T scanner with fast imaging employing steady-state acquisition (FIESTA) image sequence mode, using these acquisition parameters: TR=2.98 ms, TE=1.2 ms, flip angle=30 degrees, and slice thickness=10 mm. We investigate two categories of methods: contouring-based methods including level set (LS) and graph cut (GC) and direct estimation methods without contouring including Bayesian estimation (BE) and descriptor learning (DL). The performance is evaluated by estimation error of ejection fraction (EF), i.e., absolute difference between those obtained from evaluated methods and manual contouring by human experts.

RESULTS

For LV, direct methods produce estimation errors of 0.037 (BE) and 0.085 (DL), and contouring-based methods yield estimation errors of 0.110 (LS) and 0.097 (GC). For RV, contouring-based methods fail to do estimation due to the geometrical complexity of RV, and direct methods can estimate for bi-ventricles, i.e., LV and RV, simultaneously with impressive results of 0.049 (BE) and 0.110 (DL) for RV. Direct estimation methods outperform contouring-based methods in terms of estimation errors and yield comparable performance with baselines (i.e., inter-observer variability) which are 0.012 and 0.018 for LV and RV, respectively.

CONCLUSION

Direct estimation methods provide more accurate estimation of cardiac ventricular volumes than contouring-based methods. Moreover, they are flexible to be used for either individual or joint volume estimation of LV and RV, while contouring based methods can only apply to a single ventricle.

CLINICAL RELEVANCE/APPLICATION

Direct estimation methods have emerged as a convenient and mature clinical tool for cardiac volume estimation which enable diagnosis of cardiac diseases to be conducted in a more efficient and reliable way.

FIGURE (OPTIONAL)

** no data entered **

Disclosures:

Nothing to disclose:	Xiantong Zhen
Nothing to disclose:	Zhijie Wang
Nothing to disclose:	Ali Islam
Nothing to disclose:	Mousumi Bhaduri
Nothing to disclose:	Ian Chan
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Questions:

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