Very low mechanical index 2D and 3D contrast-echocardiography: dosages at the discretion of sonographers

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BACKGROUND

Contrast echocardiography has been widely used for the quantitative assessment of left ventricle (LV) ejection fraction in transthoracic echocardiography (TTE). The recommended dose for the bolus administration of DEFINITY®* contrast agent is a single dose of 10 µL/kg (0.6 mL, 60 kg person) followed by a 10 mL saline flush with a second 10 µL/kg dose if needed.

Dosing schemes for contrast media were established by imaging methods which were less sensitive for the detection of contrast agents than the contrast specific imaging modalities used today.

OBJECTIVE

The total contrast dosages were prospectively assessed the in a large series of patients to provide benchmarks for contrast use with current state-of-the-art scanners in an echocardiography laboratory where sonographers administer the contrast agents.

METHODS

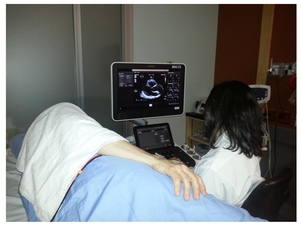
Consecutive consenting patients (n=550) referred for contrast echocardiography for the monitoring of cardiotoxic effects of chemotherapy were included. All echocardiograms and contrast injections were performed mainly by two experienced sonographers. A Philips Epiq 7C ultrasound system with a X5-1 xMatrix array transducer (1.3-4.2 MHz) was used. All consenting patients received diluted DEFINITY prepared by diluting 0.5 mL DEFINITY into a 10 mL solution with saline. Bolus injections (0.5 mL) of diluted contrast were administered using a very low mechanical index (MI ≈ 0.10 – 0.18) contrast specific imaging modality in order to provide optimal LV delineation. Additional bolus injections were administered as needed for image optimization at the discretion of the sonographer. A minimum of two 2 beat loops of the apical four, two and three chamber views were acquired in all patients as well as 3D datasets. The total volume of undiluted DEFINITY used was recorded. The reading cardiologist reviewed the TTE studies.

WORKFLOW

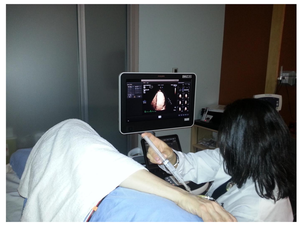
Informed consent

Intravenous initiation by sonographer/nurse

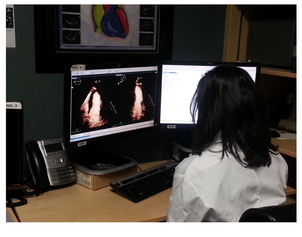
Non-contrast imaging



Contrast administration & imaging by same sonographer



Analysis



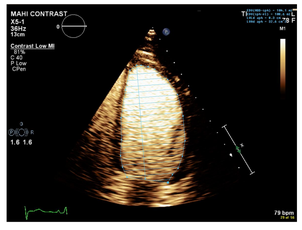
RESULTS

550 patients received contrast during their echocardiograms (Figure 1). These echocardiograms were deemed diagnostic for quantitative assessment by the sonographer. No additional injections were requested by the reading cardiologist. The mean total volume of undiluted DEFINITY used was 0.3 mL ± 0.1 mL. The mode was 0.2 mL undiluted DEFINITY. In 98% of patients ≤ 0.5 mL of undiluted DEFINITY was used. No adverse reactions were reported.

There are still limitations to quality 3D contrast echocardiography which include poor temporal resolution, multi-beat acquisition requires patient to be able to hold breath, stitching artifact from motion or arrhythmia, apical destruction of contrast, mitral annulus identification due to edge shadowing, difficulty in optimizing orthogonal plane image quality due to rib shadows, LV axis alignment, and poor imaging windows.

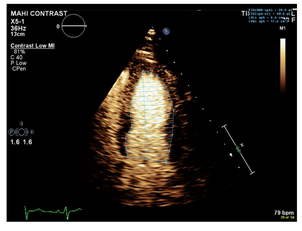
A4 end diastole

104 mL



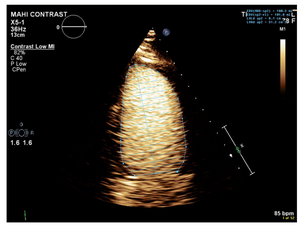
A4 end systole

40 mL



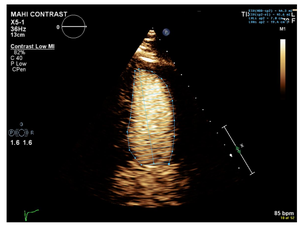
A2 end diastole

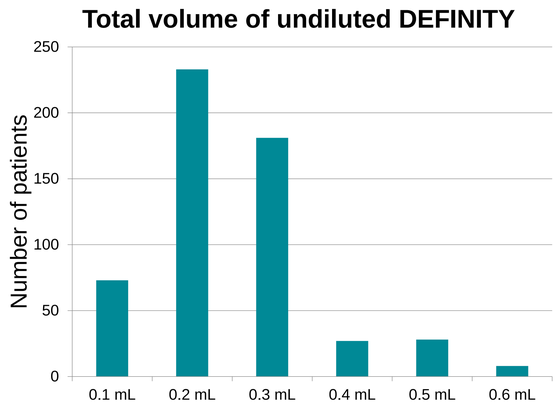
100 mL



A2 end systole

44 mL





CONCLUSIONS

A comprehensive 2D and 3D contrast echocardiography study requires only low amounts of contrast agent when using very low MI contrast modalities on state-of-the-art scanners. This can be achieved when sonographers are allowed to decide on the level of contrast required based on image quality.

REFERENCES

DEFINITY® [package insert]. N. Billerica, MA: Lantheus Medical Imaging; 2011.

AUTHOR DISCLOSURES

Ian Paterson: Janssen Inc consultant

Jonathan Choy: Philips Healthcare Speakers' Bureau, Bracco Imaging Consultant

Harald Becher: Bracco Research Grant, Bracco Speakers' Bureau

No disclosures for other authors.