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CT-based 3D printing for sizing, device positioning and prediction of device compression in the context of LAA occlusion - A comparison to transesophageal echocardiography

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THEME: Interventions for Stroke
TOPIC(S): LAA closure

AIMS

To determine whether the use of 3D-printed models of patient-specific LAA anatomy based on pre-procedural computed tomography (CT) can aid in device sizing and can predict device compression in the context of LAA closure using the WATCHMAN® device.

METHODS AND RESULTS

18 consecutive patients (73±9 years, 50% male) with atrial fibrillation requiring anticoagulation, but at high bleeding risk underwent LAA closure using the WATCHMAN® device. All patients underwent pre-procedural TEE and contrast-enhanced third-generation dual source CT imaging of the LAA. Based on CT anatomy, replicas of LAA anatomy were created by 3D printing and used to shape silicon moulds to create a hollow model of patient-specific LAA anatomy on a 1:1 scale. Pre-procedural simulation of device implantation was performed in these models. A CT scan of the occluder implanted in the 3D model was used to determine the degree of device compression. In addition, appropriate device size was estimated based on pre-procedural TEE of the LAA. LAA occlusion was performed under TEE guidance and angiographic visualization. Final implant size was compared to CT-based and TEE-based prediction. Implantation was successful in all patients. In one patient, pericardial effusion required drainage. Mean ostium diameter based on TEE was 22.2±3.9 mm, mean ostium diameter based on 3D-CT was 24.4±3.5 mm (p=0.072). 3D-CT based sizing was equal to the finally implanted device in all patients. Based on TEE, the device would have been undersized in 5/18 patients (28%, p=0.045). Compression of implanted occluders was 17.3±4.6% in TEE, which corresponded to the degree of compression determined by in the 3D-CT-model (15.1±3.1%, r=0.533, p=0.023).

CONCLUSIONS

Models of patient-specific LAA anatomy created by CT-based 3D printing may assist in device selection and can predict device compression in the context of interventional LAA closure.