

Abstract

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A Bayesian Neural Network Algorithm identifies patients in whom post-EVAR surveillance may be unnecessary

Lifelong surveillance is not cost-effective after endovascular aneurysm repair (EVAR), but is required to detect aortic complications which are fatal if untreated (type 1/3 endoleak, sac expansion, device migration). Aneurysm morphology determines the probability of aortic complications and therefore the need for surveillance, but existing analyses have proven incapable of identifying patients at sufficiently low risk to justify abandoning surveillance. This study aimed to improve the prediction of aortic complications, through the application of machine-learning techniques. Patients undergoing EVAR at 2 centres were studied from 2004–2010. Aneurysm morphology had previously been studied to derive the SGVI Score for predicting aortic complications. Bayesian Neural Networks were designed using the same data, to dichotomise patients into groups at low- high-risk of aortic complications. Network training was performed only on patients treated at centre 1. External validation was performed by assessing network performance independently of network training, on patients treated at centre 2. Discrimination was assessed by Kaplan-Meier analysis to compare aortic complications in predicted low-risk versus predicted high-risk patients. 761 patients aged 75 +/- 7 years underwent EVAR in 2 centres. Mean follow-up was 36 +/- 20 months. Neural networks were created incorporating neck angulation/length/diameter/volume AAA diameter/area/volume/length/tortuosity and common iliac tortuosity/diameter. A 19-feature network predicted aortic complications with excellent discrimination and external validation (5-year freedom from aortic complications in predicted low-risk vs predicted high-risk patients: 97.9% vs. 63% p < 0.0001). A Bayesian Neural-Network algorithm can identify patients in whom it may be safe to abandon surveillance after EVAR. This proposal requires prospective study