Introduction
Rupture risk for an abdominal aortic aneurysm (AAA) is currently predicted from maximum diameter and diameter growth. Previous studies indicated that AAA wall stress, incorporating the 3D geometry, is more reliable.

Aim
- To improve AAA wall stress analysis for future diagnostic purposes by performing patient specific wall stress analyses at different levels of complexity.
- To evaluate the relation between AAA wall stress and growth rate.

Methods
38 patients with maximum AAA diameters between 40 and 55 mm were included. Patients were in follow-up for one year, in which CTA scans were made every 4 months.

Wall stress analysis
The AAAs were semi-automatically segmented from the first of two consecutive CTA scans and converted into a finite element mesh of the AAA wall with a thickness of 2 mm consisting of quadratic tetrahedral elements (Fig.1). Wall stresses were computed with Sepran.

Complexity
AAA wall stresses were compared including and omitting:
- initial stresses, resulting from the blood pressure at CTA
- thrombus
- calcifications

Growth rate
AAA growth rate was determined from the change in AAA diameter between two consecutive CTA scans.

Results
Omitting initial stress leads to an overestimation of the wall deformation. Small blebs were smoothened out, which resulted in lower wall stresses (Fig.2).

Fig.2: AAA wall stress without (left) and with (right) initial stress
Including thrombus resulted in lower wall stresses (Fig.3).

Fig.3: AAA (left), wall stress without (middle) and with (left) thrombus
Including calcifications resulted in higher wall stresses (Fig.4).

Fig.4: AAA (left), wall stress without (middle) and with (left) calcifications
All effects differed in size between AAAs and no general correction factor could be found for either initial stress, thrombus or calcifications. Medium or high wall stress could be associated with an increased AAA growth rate (Fig.5).

Fig.5: AAA growth rate versus AAA wall stress

Conclusion
Increased growth was found for higher wall stress AAAs. However, further improvements, such as including patient specific wall thickness and material properties are required before AAA wall stress can be used in diagnostics.