CAAS QCA

The applications and benefits of quantitative coronary angiography
Coronary angiography is routinely used for diagnosis and treatment of millions of patients who have or are at risk of coronary artery disease. In clinical practice visual estimation (eye-balling) is a common way of evaluating coronary angiograms. Visual estimation has however several limitations, e.g. high variability associated with operator experience and only general estimation of the vessel dimensions. Quantitative Coronary Analysis (QCA) being highly accurate and reproducible can refine the visual estimate and provide several important measurements of the coronary anatomy. The use of QCA to support visual estimation has therefore mayor benefits in clinical routine. In research QCA is the most frequently used analysis tool for evaluation of novel interventional methods, pharmaceuticals and devices.

This document gives insight into the applications and benefits of using QCA in clinical and research practice and describes the unique features CAAS QCA has to offer.

Applications and benefits

Clinical Practice

In clinical practice physicians have to make decisions about the type of intervention and the most appropriate devices and their sizes. Due to the limitations of visual estimation there is a need for quantitative measurements. A recent publication by Girasis et al [1] demonstrated the need for quantitative measurements by determining the agreement between visual assessment and true percent diameter stenosis in bifurcated vessels (see figure below). Girasis et al also referred to earlier studies which reported on discrepancy between visual and QCA estimates of percentage stenosis in single vessel lesions and the large inter- and intra-observer variability of visual estimation.

CAAS QCA offers several quantitative measures that are valuable to support the physician in deciding the best treatment for the patient. When used in clinical practice, QCA is carried out during coronary angiography or before, during and after PCI.

**Stenosis severity**

QCA can be used in clinical practice to have an objective and independent parameter for the assessment of stenosis severity. QCA provides a single specific measure for percentage stenosis and minimum luminal diameter (MLD), while visual assessment provides a general estimation and is highly influenced by physician experience. Clinical and experimental studies have shown that in the case of >50% stenosis the coronary flow reserve is reduced and thus revascularization of the vessel is indicated [1]. By providing an accurate and objective measurement for severity of the stenosis, QCA helps the physician in deciding whether or not to treat a coronary lesion.

**Lesion length and reference vessel diameter**

The principal application of QCA is the objective assessment of lesion length and reference vessel diameter measurements. By providing these measurements, QCA helps the physician decide which device (e.g. balloon, stent, length and diameter) should be chosen. Matching the size of the device to the artery is required to minimize vessel damage that may result in acute vessel occlusion and late restenosis [1]. Also the need for additional stenting as a result of incomplete lesion coverage is expected to decrease.

Another application is the prediction of the effectiveness of PCI through an immediate postprocedural QCA. The risk of restenosis can be predicted from the known length of the stent and the
quantitative measures of the residual diameter stenosis after stent implantation [2].

**Research setting**

In a research setting QCA is used after completing coronary angiography or intervention, to evaluate the effectiveness of treatments, such as balloon or stent placement or drug treatment. For studies on coronary devices, QCA is performed on images acquired before treatment, immediately after treatment and at follow-up. Dedicated core laboratories usually perform the analysis to obtain independent analysis. The most important parameters in research, calculated using QCA, are:

- Acute luminal gain; gives insights on the acute efficacy of the device and is defined as postprocedural MLD - preprocedural MLD
- (Late) luminal loss; estimator for restenosis and defined as postprocedural MLD – MLD at follow-up
- Binary angiographic restenosis; the incidence of percent diameter stenosis >50% at follow-up

The **reproducibility** and **operator independence** of these measurements by use of QCA have increased allowing researchers to compare different types of devices in trials with greater statistical power and thus fewer patients [2].

**Unique product features**

**Extensively validated**

Several studies have shown the high accuracy and precision as well as the low inter- and intra user-variability of CAAS QCA [3, 4, 5].

**Single click analysis**

With just a single click a QCA analysis can be performed to save valuable time.

**Contour detection**

CAAS 5 QCA employs an improved version of the original CAAS contour detection algorithm by using the densitometrically determined cross-sectional area to enhance the results of the classic algorithm. This especially improves the accuracy of small vessels and vessel parts (< 1.5 mm). The improved algorithm results in a reduced need for user input, which makes analyses quick and more reproducible.

**Dedicated bifurcation analysis**

CAAS QCA offers a dedicated bifurcation analysis option to overcome the major challenges in quantifying bifurcation lesions as described by Ramcharitar et al [6].

**Restriction**

Corrections of the automatically detected contour reduce the reproducibility and operator independence of the analysis. CAAS QCA therefore offers the option to perform a restriction. A restriction prevents automatic contour detection of non-relevant objects in the image, typically structures that do not belong to the vessel segment of interest.

**Densitometric area information**

When only one projection of a vessel is available and the vessel is asymmetric or eccentric no meaningful area information can be calculated from the cross-sectional diameter based on the assumption of circularity. Densitometric information is based on the contribution of the amount of contrast medium for each position in the artery and therefore is able to provide meaningful area information in these cases.
Analysis of Total Occlusions (100% stenosis)

Total occlusions can be analyzed. In research studies this is a great benefit because now also for these cases pre- and post data can be compared and these patients can be included. In clinical practice the length of the total occlusion is important to choose the appropriate length of the device.

DES analysis

For easy and accurate assessment of the effectiveness of PCI using Drug-Eluting-Stents (DES), CAAS QCA offers a dedicated research option enabling analysis of the stent segment as well as vessel segments proximal and distal to the stent (usually of 5mm).

Conclusion

QCA can be easily applied during routine coronary angiography and during PCI to support daily decision making such as whether to stent and if so which stent should be used. Extensive validation studies have proven the excellent accuracy, precision and reproducibility of CAAS QCA and currently it is the most used QCA software in cardiovascular research and interventional cardiology. Therefore we can conclude QCA continuous to offer important insights for clinical research and clinical practice. To overcome the limitations of 2D single vessel QCA, QCA is continuously improved and expanded with new analysis options like 2D bifurcation QCA, 3D single vessel and 3D bifurcation QCA.

References
