Chapter 1

The application of gated SPECT in nuclear cardiology. Introduction and outline
INTRODUCTION

Coronary artery disease is the leading cause of death in western countries and has a major impact on modern society [1,2]. In the latter part of the last century several dramatic changes, because of technological advances or improved therapeutic options, occurred in the care and management of patients with coronary artery disease. As a result of both new or improved diagnostic and therapeutic capabilities, significant chances took place in the population with respect to the occurrence of various patterns of ischemic heart disease. The improvement in survival after acute myocardial infarction resulted in a markedly increased population of patients with more or less extensive cardiac disease. Patients tend to be older and to have a more severe extent of disease. The advances in medical management come with an increase in cost [3]. Costs have become the major factor in the development and implementation of clinical protocols for the management of this patient group [4,5]. In this setting it becomes more important to go beyond establishing a diagnosis of coronary artery disease, and towards the level of risk stratification [3]. This need for risk stratification applies to patients with either acute or chronic coronary artery disease.

Stress test is a technique to assess information about myocardial perfusion. However, under certain conditions the sensitivity or the specificity of the stress test dropped to low levels. For instance in patients with a history of myocardial infarction, or with an acquired left bundle-branch block, or in those unable to attain the required exercise level, the electrocardiographic criteria often proved too crude [6,7]. Especially in women, the diagnostic power of the stress test appeared to be quite disappointing [8-11]. Although some reports indicate that gender-specific criteria may result in significant improvements [12].

Coronary angiography enables us to assess coronary artery stenosis, wall motion and left ventricular ejection fraction (LVEF). Unfortunately this is a costly and invasive procedure. Myocardial perfusion scintigraphy provides additional information about myocardial perfusion, but with far less anatomical detail. It is essentially noninvasive. Main use of myocardial perfusion scintigraphy is in risk stratification and in the assessment of the presence of reversible ischemia in patients with known or suspected coronary artery disease. As such it is used as a diagnostic pre-filter. It was concluded that patients with either a very high, or a very low prior risk for ischemic heart disease should not undergo myocardial perfusion scintigraphy [13] (figure 1). In a large proportion of patients with an intermediate probability of reversible ischemia, no reversible ischemia is actually present. These patients do not have to undergo invasive procedures. Such patients are preferably treated with medication only. This management strategy proved to be cost-effective in patients at an intermediate risk for cardiac events due to coronary artery disease [14-18].

RADIOPHARMACEUTICALS

In the early 70’s thallium-201 ($^{201}$TI) was introduced as a potassium analogue [19-21]. It has more favourable radio-physical features than radioactive potassium.
Although $^{201}$Tl performed reasonably well in patients at an intermediate risk, the number of patients that were wrongly diagnosed (false positive and false negative combined) still exceeded 10% [15, 22-26]. Thallium was not an ideal pharmaceutical for perfusion scintigraphy. It has a low photon energy (80 keV) and a rather long half-life of 72 hrs. Technetium-99m ($^{99m}$Tc) has a half-life of 6 hours and therefore permits the use of a larger amount of radioactivity. Also the higher photon-energy (140 keV) results in less scatter and less attenuation. Both factors contribute to an improvement in image quality.

A number of $^{99m}$Tc-based pharmaceuticals has been developed and introduced for myocardial perfusion imaging, based on the assumption that their use would result in an increased image quality and thereby a significant improvement in diagnostic performance. The former proved to be true in practice, especially with the use of single photon emission computed tomography (SPECT) and more recently the use of gated SPECT. Some studies indicated a reduced number of borderline diagnoses especially with the application of gated SPECT technology [27,28].

$^{99m}$Tc-hexakis-2-methoxy-2-methylpropyl-isonitrile ($^{99m}$Tc-MIBI) was one of the first and most successful $^{99m}$Tc-based pharmaceuticals. Tetrofosmin became available somewhat later in the nineties. Its clinical introduction and initial evaluation in humans took place ‘in the wake’ of the introduction of $^{99m}$Tc-sestamibi for myocardial perfusion scintigraphy. Tc-99m-1,2 bis [bis (2-ethoxyethyl) phosphinol] ethane, (tetrofosmin, Myoview®, Amersham International U.K.) is cationic and lipophilic. The most likely mechanism for the uptake of $^{99m}$Tc tetrofosmin is by potential driven diffusion of the lipophilic cation across the sarcolemmal and mitochondrial membranes [29-32]. $^{99m}$Tc-tetrofosmin shows little if any redistribution. The absence of redistribution is the reason for $^{99m}$Tc-tetrofosmin administration during both stress and rest. The uptake in the myocardium is rapid. Approximately 1.2% of the injected dose of $^{99m}$Tc-tetrofosmin can be found in the myocardium within five minutes. It remains stable for the first hour, then gradually drops to 1.0% at 2 hours and 0.7% at 4 hours. At 24 hours only 0.2% of the injected dose was still present in the myocardium. The clearance from the bloodstream is rapid, with less than 5% remaining in the blood pool at 10 minutes post-injection. Approximately
66% of the injected dose activity is excreted within 48 hours post-injection with approximately 40% excreted in the urine. Faecal clearance varies between 17 and 41% with a tendency towards lower faecal clearance after exercise [33]. The uptake in many organs was dependent upon the exercise level at the time of injection. The uptake in lungs, liver, gallbladder, kidneys, thyroid and gastrointestinal tract all showed a 1.2 to 2.2-fold decrease in uptake after exercise [33]. Early liver uptake dropped rapidly from 4.9-10.6% of the injected dose at 5 minutes to less than 1.6% at two hours [33]. The gallbladder activity reaches its peak at 2 hours. At rest it can contain up to 11% of the injected dose. The relatively high liver activity is the major disadvantage of $^{99m}$Tc-based pharmaceuticals. Therefore, image acquisition starts 45 to 60 minutes after administration. The lung uptake is low, resulting in heart-to-lung ratios of 3 to 5 minutes post injection and rapidly improving with time [33].

Side-effects are very rarely seen. After intravenous injection a very small number of individuals notices a “metallic” taste, or reports mild nausea. To date so far, no serious side-effects have been reported [34].

Besides information on myocardial perfusion it is also important to be informed about the left ventricular function. The high count density achieved with $^{99m}$Tc-tetrofosmin and the fact that $^{99m}$Tc-tetrofosmin retains in the myocardium make it possible to analyse left ventricular function, even until several hours post injection.

**LEFT VENTRICULAR FUNCTIONAL IMAGING MODALITIES**

The left ventricular ejection fraction can be derived from scintillation by several different diagnostic methods. The ventricular pump function can be measured by imaging the cardiac transit of an intravenously administered bolus of radioactivity, first-pass radionuclide angiography [35,36]. A bolus of tracer is imaged as it passes through the cardiac chambers. End-diastolic (EDC) and end-systolic (ESC) counting rates are measured during left ventricle (LV) bolus transit and corrected for the background, represented as a time activity curve. The peak shows the heart in end-diastolic phase (ED) and the lowest point of the curve shows the heart in end-systolic phase (ES). The left ventricular ejection fraction is calculated by the formula: $\text{LVEF} = \frac{\text{ED} - \text{ES}}{\text{ED}}$. The ejection fraction is based on the amount of radioactivity (number of ‘counts’) and is not based on the geometry of the ventricle.

The second, more commonly used, method is equilibrium radionuclide ventriculography [35]. With the latter method autologous red blood cells are labelled with $^{99m}$Tc-pertechnetate resulting in high-contrast imaging of vascular space. ECG triggered (synchronic with the R-top signal) data on gated ESC and EDC acquired over several hundred cardiac cycles are summed, and corrected for background. Depending on the method of data acquisition the RR-interval is divided into 16 to 24 frames. The division of the cardiac cycle into more frames is called ‘multiple-gating’. Computer programs assess count-rate changes, yielding measurements of global and regional ejection fraction, volumes, and emptying and filling rates of left and right ventricle [35,37,38]. The analysis of global and regional left ventricular function can be assessed either at rest or during stress. This is all viewed in cine format. The contractile reserve
can be assessed by this method and used as a sensitive test for impaired global and regional ventricular function.
A number of potential errors that can affect the accuracy of LVEF measurements has been explained in literature, such as poor definition of blood pool edges, inadequate gating, insufficient separation of left and right ventricles, significant soft tissue attenuation over the left ventricle and inappropriate background subtraction [35].

**Evolution of myocardial function and perfusion imaging.**

In 1984 Narahara et al. [39] were the first to report the ability of combining assessment of ventricular function and myocardial perfusion during one single test using bicycle exercise. Gold-195m with a half-life of 30.5 seconds was used for first pass radionuclide angiography (RNA) and thallium-201 was used for the assessment of the myocardial perfusion. Immediately after the administration of 2 mCi of thallium-201, approximately 20 mCi of gold-195m was injected to obtain an exercise first-transit study that required 30 seconds of acquisition time. Within 5 minutes after the acquisition of the first-transit study and the termination of exercise, the acquisition of the myocardial perfusion imaging started. Three hours thereafter, the redistribution images were obtained.

Verani et al [40] used iridium-191m, with a half-life of 4.96 seconds, for measuring the LV function with RNA, a few years later. The myocardial perfusion was measured using $^{201}$Tl immediately following first pass RNA. Later, several studies reported the use of $^{99mTc}$-labeled agents to obtain information about the condition and behaviour of ventricular function with RNA and myocardial perfusion simultaneously [41,42]. In 1989 Najm et al [43] reported that they assessed a method of providing information on the left ventricular function as an adjunct to myocardial perfusion imaging using Tc-99m MIBI (2-methoxy-2-methyl-isopropyl-isonitrile). Radionuclide fractional shortening was calculated from the anteroposterior and the septum to lateral wall axes (on the anterior oblique 45° view) in diastole and systole. Data were acquired from 18 frames per cardiac cycle. The global fractional shortening correlated closely with left ventricular radionuclide ejection fraction.

The introduction of single photon emission computed tomography (SPECT) [44-46] and the continuously improving imaging hardware and reconstruction software allowed the creation of three-dimensional images of the left ventricle. The SPECT technique has several advantages over planar imaging for the analysis of perfusion and function, such as improved resolution, differentiation of overlapping myocardial regions, improved sensitivity and specificity of diagnoses, depiction in planes familiar to cardiologists and colour images improving interpretation and presentation. Due to these developments the assessment of left ventricular function and perfusion during one single acquisition has assumed enormous proportions; In 1990 Marcassa et al. [47] analyzed regional wall thickening with Tc-99m MIBI with a method based on the partial volume effect (the systolic-diastolic changes in the detected radioactivity would reflect changes in myocardial wall thickness). The myocardial perfusion images were gated in 16 frames per R-R interval. The left ventricular end-diastolic and end-systolic edges were manually drawn; this was the only operator-dependent procedure.

Faber et al. (1991) reconstructed a tomographic radionuclide ventriculogram with a 16-frame gated SPECT acquisition using $^{99mTc}$-MIBI and a cylindrical co-ordinate system was used to determine left ventricular surface points [48]. Global variables, such as volumes, ejection fraction, and myocardial mass were computed. Otherwise from asking the user to identify
the left ventricular long axis, the method was entirely automatic. The automatically calculated motion and perfusion values from gated SPECT images were validated by comparing them with those determined from hand-traced surfaces of cardiac rotation magnetic resonance (MR) images. In 1993 DePuey et al. [49] reported on the calculation of the LVEF using an 8-frame gated SPECT myocardial perfusion acquisition after injection of $^{99m}$Tc-MIBI. The endocardial borders were manually drawn at a count level of 34% of the maximum. The LVEF was derived from end-diastolic and end-systolic endocardial borders. LVEFs calculated from gated MIBI SPECT ranged from 0.21 to 0.73 and correlated linearly with gated blood-pool values with correlation coefficients ranging from 0.79 to 0.88. Intra-observer and inter-observer reproducibility in determination of LVEF from gated MIBI SPECT were suboptimal ($r=0.75$). Hambye et al. [50] reported in 1997 on ECG-gated SPECT imaging. Eight time-frame gated SPECT data was collected, using $^{99m}$Tc-sestamibi. Ejection fraction was calculated using a semiautomatic edge-detection technique based upon a threshold-searching method and compared with values obtained from first-pass or equilibrium radionuclide angiography. End-diastolic and end-systolic bins were selected manually by the observers on a short-axis image, using a colour cine-loop display. End-diastolic and end-systolic endocardial borders were drawn automatically on the mid-ventricular vertical (VLA) and horizontal long-axis (HLA) images at 80% of the maximum profile activity. An elliptical interpolation was applied at end-diastole and end-systole between the borders determined on these orthogonal slices to calculate the corresponding volumes. In patients with regions of severely impaired perfusion, especially those involving extended regions of the left ventricle, the thresholding algorithm was unable to draw the endocardial border accurately and therefore manual determination was necessary. Despite slight discrepancies between gated SPECT with other radionuclide angiographic methods at extreme LVEF values (under- or overestimation with gated SPECT for absolute values below 40% and over 65% respectively), there was a good correlation observed over a wide range of values. Good reproducibility was noted, with an inter- and intra-observer variability of $-0.2 \pm 3.5$ (range $-7.6$ to $6.9\%$, $r=0.97$) and $-0.2 \pm 2.2\%$ (range $-5.9$ to $3.5\%$, $r=0.99$) respectively. In that same year, Calnon et al. [51] developed a new gated SPECT method for computing the global LVEF based entirely on changes in maximum regional myocardial counts during systolic contraction, independent of endocardial edge detection or other geometric measurements. By quantifying the changes in maximum pixel counts (partial volume effect), regional systolic wall thickening could be assessed.

**QUANTITATIVE GATED SPECT (QGS).**

**introduction**

A disadvantage of the described techniques to acquire left ventricular function is the non-automatic delineation of the myocardial border and hence operator dependency which may lead to a higher inter-observer variability compared to a totally operator independent method. Germano et al. [52-59] developed a complete automatic algorithm: quantitative gated SPECT (QGS). With this method it is possible to quantify the left ventricular cavity volumes, the left ventricular ejection fraction and to visualize left ventricular wall motion and wall thickening.
Figure 2. Left: Screen display with short and long axis images with overlaid endocardial and epicardial contours. Short axis images are used as input. Under: Four dimensional (three dimensional plus time) display screen utilized for the assessment of global and regional myocardial function. Gated short axis images are used as input.
This algorithm uses gated short-axis data sets after stacking them together to form a three-dimensional image volume (figure 2).

Automatic segmentation of the left ventricular myocardium will take place, based on initial heuristic thresholding, binarization, and clustirification of the three-dimensional image, followed by iterative cluster refinement using pixel erosion and pixel growing (repetitive dilatation). The classical Hough transform is applied to detect contiguous local maxima forming approximate circles [60,61]. Each circle is assigned a score proportional to the average count value along its circumference and the ratio of that value to the average count at the center, so as to favour doughnut-like count distributions. The circle with the highest score is deemed the most likely to represent the left ventricle and is expanded by 2 pixels outwards. For three-dimensional short-axis volumes, all voxels outside the cylinder with that circle for section are discarded. Once the left ventricle has been isolated and its centre of mass is automatically determined, rays are drawn from it according to a spherical sampling model. From this a first estimate is defined of the three-dimensional midmyocardial surface, which is then fitted to an ellipsoid. The best-fit ellipsoid defines new sampling co-ordinate system, along which count profiles normal to the myocardium are measured and fitted to asymmetric Gaussian curves. Endocardial and epicardial surfaces are determined based on the Gaussians’ standard deviations. The valve plane is determined by fitting a plane to the most basal myocardial points. Contours are generated even in apparent absence of perfusion because Gaussian fitting operates on the segmented but non-thresholded image, and is thus able to discern very low levels of perfusion. Thereby, contours are generated by maximizing the smoothness of the surface patch defined by the invalid points (extrapolating those of points immediately adjacent to the nonperfused area) [52-59].

Regional wall motion is the excursion of the three-dimensional endocardial surface from end-diastole to end-systole. Segmental thickening is calculated using both geometric and count considerations (partial volume effect) [52-59].

Gated SPECT takes full advantage of the properties of \(^{99m}\text{Tc}\) perfusion agents, namely high count rates and stable myocardial distribution with time. Because the tracer distribution in the myocardium is stable, spatial and temporal changes in the myocardial tracer activity during the cardiac cycle reflects regional myocardial wall motion and wall thickening. An advantage of this technique is the possibility to assess perfusion and function during one single acquisition.

Gated SPECT imaging validation by other methods.

Functional data on the left ventricle acquired by the gated SPECT technique has been compared with other well-known imaging modalities such as magnetic resonance (MR) imaging, contrast angiography, echocardiography, gated blood pool imaging and RNA [53,62-71]. These studies
reported a good to excellent agreement between these imaging modalities and gated SPECT. Bavelaar-Croon et al. [70] found a correlation coefficient of 0.85 for the LVEF measured by gated SPECT as compared to MR imaging. They also found an excellent correlation coefficient for both the left ventricular end-diastolic volume (LVEDV) and left ventricular end-systolic volume (LVESV): r=0.94 and r=0.95 respectively. Higher mean LVEDV and LVESV were measured by gated SPECT as compared to MR imaging, but the differences were not significant. This finding is due to inclusion of part of the outflow tract with MR imaging. Vaduganathan et al. [66] found in 25 patients with an acute myocardial infarction an exact agreement for wall motion scores in 92% of the segments with a kappa of 0.82 between gated SPECT and MR imaging. Correlations between the two techniques were also good for LVEDV, LVESV and LVEF resp. r=0.81, r=0.92 and r=0.93. Atsma et al. [69] compared LVEF data acquired by gated SPECT and LVEF measured by contrast ventriculography in 74 patients. The authors found a good correlation (r=0.84) between the two imaging modalities. They also found exact agreement of segmental wall motion scores on a 4-point scale in 89% of the segments with a kappa value of 0.76. Bacher-Stier et al. [67] reported a correlation coefficient of 0.86 between the LVEF measured by gated SPECT and echocardiography in rest. Moreover, using echocardiography as reference standard, regional wall motion abnormalities were identified by gated SPECT with high sensitivities (88%-100%) and high specificities (82%-98%).

**Quantitative Gated SPECT, the version used in this thesis.**

Visual interpretation of myocardial wall motion and wall thickening has been shown to provide important diagnostic and prognostic information in various groups of patients with known or suspected coronary artery disease [72]. However, substantial operator dependency, intraobserver and interobserver variability in interpretation compromise the reproducibility of non-automatic and non-quantitative techniques. Germano et al. [54,73] has developed a new approach to a quantitative analysis of the regional wall motion and wall thickening. The algorithm uses also ellipsoid fitting and sampling of the myocardium and generates non-slice-based analysis of relative myocardial perfusion, independent of the size, shape, and orientation of the left ventricle. In addition to a numeric measurement of the extent, severity, and reversibility of perfusion defects, the approach provides automatic, computer-derived segmental scores, analogous to the semiquantitative 20-segment, 5-point (0-4) visual scores model, and the option for building customized normal databases. Perfusion at each myocardial sampling point was calculated as the average uptake along the count activity profile (endocardial-epicardial segment) normal to the myocardium and passing through that point [54,56,58,73]. Endocardial and epicardial surfaces were derived even in areas of apparent absence of perfusion using rule-based criteria ensuring the continuity of surface myocardial count profiles (as described above) [56,58]. Normal limits and abnormality criteria for relative myocardial uptake, for each of the 20 myocardial segments, seen during stress $^{99m}$Tc-sestamibi imaging and rest $^{201}$Tl imaging were developed [56,58,73]. This thesis is based on Cedars-Sinai’s Quantitative SPECT (QGS) software program developed by G. Germano (version 2.0, revision A”figure 2) [52].
CONSIDERATIONS AT THE START OF THE STUDY

Diagnostic value of gated SPECT myocardial perfusion imaging.

The sensitivity of exercise perfusion imaging for detecting angiographically significant CAD ranges from 85-91% [13]. The specificity ranges from 70-94%. The addition of SPECT to exercise testing increases the diagnostic accuracy to detect CAD, with no significant differences between men and women [74-76]. Factors that affect the diagnostic performance are referral bias [76], reduced stress tolerance [77,78], anti-angina medication [79-80], imaging problems like tracer activity below diaphragm [81,82], photon attenuation and scatter, patient motion, low count statistics, reconstruction artifacts [23]. It can be such a large bias that it is likely to have a negative impact in discussions on the role of perfusion scintigraphy in patient management.

The addition of left ventricular function parameters assessed by gated SPECT has improved the diagnostic value [27,28]; as an attenuation artifact usually will show a fixed perfusion defect with concomitant preserved wall thickening and/or motion, whereas a region with a fixed perfusion defect due to myocardial infarction will show absence of wall thickening and or motion. Gated SPECT may show absence of wall thickening potentially indicating necrosis or stunning, and conversely, gated SPECT may show concomitant preserved wall thickening in the infarct region suggesting preserved viability.

Potential limitation of perfusion imaging is the measurement of relative myocardial blood flow, rather than absolute blood flow. In patients with multivessel CAD, the degree of ischemia may be underestimated because of globally reduced perfusion of the left ventricle. Overall sensitivity for identifying any SPECT abnormality of the combined perfusion/ function assessment in three vessel disease is 80-95%, and for two or single vessel disease 92% and 86%, respectively [83-85]. The overall specificity is 72% [85].

Transient ischemic LV dilatation (TID) on myocardial perfusion imaging indicates a significant enlargement in LV size on the stress images compared with the rest images. Abnormal TID is related to a greater amount of ischemic burden as well as multivessel-type or LAD territory perfusion abnormality [86-88].

In the line of risk stratification viability assessment is an important subject. For example, in patients with established extensive coronary artery disease, it is considered worthwhile to salvage even small areas with viable contractile cells [89]. However, revascularisation in patients with extensive coronary artery disease is associated with a considerable risk of periprocedural complications, so it is only justified in patients with remaining viable but dysfunctional myocardium [90,91].

Several imaging modalities are potentially available. Positron emission tomography can be used to detect areas of increased ¹⁸F-fluoro-deoxy-glucose (FDG) uptake, as a prove of altered glucose metabolism. Alternatively, the gated SPECT technique can help distinguish contractile from non-contractile myocardial tissue at places with borderline perfusion [92]. Improvements in local perfusion after specific therapy is taken as conformation of viability.

The main use of myocardial perfusion imaging is in the assessment of the presence of reversible ischemia, as such it is used as a diagnostic pre-test for coronary angiography. The prognostic side of myocardial perfusion imaging, as extra information on a diagnostic study, is not commonly used. The prognostic side of myocardial perfusion imaging could be used in a
more structural manner for the management of patients with coronary artery disease. Patients with a very low probability [<1 % per year] for cardiac events can be discharged from follow-up. This management can lead to a gain in efficacy and cost-effectiveness. The evaluation of the incremental prognostic value of the left ventricular ejection fraction, as can be obtained from gated SPECT data, may be important for the risk stratification of patients with extensive coronary artery disease.

**Subpopulations**

Myocardial perfusion scintigraphy is used for a wide range of distinct clinical purposes (subgroups). Among these subpopulations the relative frequencies of certain findings, and thereby both the prognostic value, and the diagnostic performance of perfusion imaging will vary enormously. For instance, the majority of the data on prognostic value of the parameters assessed by gated SPECT has been obtained in a mixed gender population and may not be applicable to women. Women often have smaller LV volumes. It has been shown that gender related differences in normal limits exist [93-95]. In addition, a multicenter phantom study showed a wide range of results in different standard end-systolic and end-diastolic volume combinations. Moreover, the LV ejection fraction (LVEF) was overestimated and both the end-systolic volume (ESV) and end-diastolic volume (EDV) were underestimated. Especially, this is the case for small volumes. Cutoff values for LV functional parameters should be validated in each center [95].

As the case mix varies from institution to institution, the interpretation of pooled data is difficult at best [96].

The importance of rigorous and extensive reporting at the subgroup level, especially for risk assessment, was emphasized in an invited commentary in the American Journal of Epidemiology [97].

**THE LEIDEN TETROFOSMIN DATABASE**

At the Leiden University Medical Center $^{201}$Tl was routinely used for myocardial imaging until its replacement by $^{99m}$Tc-tetrofosmin. After a trial period, tetrofosmin is being used in all patients referred for myocardial perfusion scintigraphy since August 1995. In addition to some basic demographic data, relevant clinical parameters, from the medical history or on the level of exercise reached during the stress test are reported in a well-standardised manner. Reporting was routinely performed by an experienced nuclear medicine specialist and a cardiologist in consensus reading. Since November 1997, the patients underwent imaging according the gated SPECT technique routinely.

All data were systematically and prospectively entered in a computerised database, that on July 1st 2000 held data on more than 2350 procedures in over 2000 patients. Where available, data was added on any angiography procedure, angioplasty procedure or coronary bypass operation performed prior to or shortly after the scintigraphic procedure. This extensive database, including follow-up data, formed the basis for the studies presented in this thesis.
AIM AND OUTLINE OF THE THESIS

The aim of the thesis is to further expand our insights in the prognostic and diagnostic value of myocardial perfusion imaging using the gated SPECT technique according to the Cedars-Sinai’s Quantitative Gated SPECT (QGS) software [52]. We studied the robustness of the QGS technique, assessing the quantitative segmental score of wall motion, wall thickening and left ventricular volumes. Following this validation, the additional prognostic value of gated SPECT on subgroup level was investigated.

In Chapter 2 we evaluated the reproducibility and operator dependence for the quantitative regional left ventricular functional parameters assessed by Cedars-Sinai’s Quantitative automated gated SPECT (QGS) software.

In Chapter 3 left ventricular function parameters at rest were compared to LV function parameters 30 minutes post-stress in patients with a myocardial infarction: evaluation with gated SPECT.

In Chapter 4 the prognostic value of gated SPECT in patients with a left bundle branch block was evaluated.

In Chapter 5 we evaluated the additive prognostic value of perfusion and functional parameters assessed by gated SPECT in women.

In Chapter 6 a review is presented of the relevant literature on prognostic value of gated SPECT imaging.

Chapter 7 contains a summary, general discussion and future perspectives.
REFERENCES


34. MYOVIEW product monograph Ref: Sas:985 Nycomed Amersham plc, U.K.


