

---

## Volume 10 - Issue 4, 2010 - Cover Story

### Cardiac Imaging

---

Cardiovascular diseases are ranked as the leading causes for mortality in most Western regions which has led to development of preventive and curative measures. According to World Health Organization (WHO) estimates, 16.7 million people around the globe die of cardiovascular diseases each year. This is over 29 percent of all deaths globally. Recent studies suggest that the largest percentage increase would occur in the Eastern Mediterranean region and the largest number of deaths is likely to occur in the South-East Asia Region. Research also predicts the cardiovascular disease mortality rate in China to rise by 73 percent by 2030. Every year, four million deaths are caused by cardiac disorders in Europe, and the direct and indirect costs of such diseases amount to over 150 billion dollars annually.

Medical imaging is the fulcrum of diagnosis for most cardiovascular diseases. The cardiac market witnessed a slow down in 2008 - 2009 owing to the lack of reimbursements mostly for cardiac CT and cardiovascular MRI procedures. However, with the increase in the number of cardiovascular imaging procedures and technological advancements, the cardiac imaging market represents great potential.

#### Computed Tomography

The advent of computed tomography (CT) has revolutionised the face of radiological diagnosis. CT continues to be a central modality in both inpatient and outpatient care. It is one of the few modalities that have undergone transformation in terms of technological advancement and product innovation since its inception in the 1970's. The recent past has seen a transition from low end 16 slice systems to high end 320 slice systems. Recent studies estimate that over 62 million CT scans are obtained per year in the United States itself which includes four million for children. The economic downturn and limited annual budgets have forced hospitals to go in for low end slice configurations.

With the increase in awareness about radiation exposure and its effects in the long run the market is shifting towards a trend where vendors are looking at radiation dose reduction technologies and reconstruction software. The battle of the slices has drawn to a close with the focus now being on sharper images that involve lower radiation dosage and reduced examination time. CT scanners with lower dosage and greater image clarity ensuring better diagnosis and treatment, is likely to be the order of the day.

Key players like Philips have introduced reconstruction technologies like iDose which would reduce the dose by 80 percent in parts of the body particularly with high organ dose. A procedure which would typically deliver six to eight millisieverts with a technology like iDose would now deliver only 0.9 mSv. iDose can also reduce the dose of coronary CT angiography studies to 0.25 to 1 mSv, which is an 80 percent reduction over conventional filter back projection reconstruction.

Both Siemens and GE also offer "iterative reconstruction", a technique that involves algorithms that help reconstruct 2D and 3D images. This technique did not see much growth owing to its slow speed; however these limitations have been overcome. IRIS (Iterative Reconstruction in Image Space) by Siemens claims a dose reduction up to 60 percent, while GE's ASIR (Adaptive Statistical Iterative Reconstruction) packaged with their LightSpeed VCT XTE and their Discovery CT750 HD claims a dose reduction of 40 to 50 percent.

There is a growing trend towards advancements in scanning speed which reduces examination time which in turn results in lower doses. GE's SnapShot pulse technology helps reduce cardiac CT doses up to 83 percent. Siemens also offers SOMATOM Definition Flash Dual Source CT scanner with advanced scanning speed which is capable of doing an entire scan of the chest in 0.6 seconds. The market is shifting towards sharper image quality without having to pay the price of higher dose. CT Angiography (CTA) is gaining prominence as it is an effective tool for diagnosing coronary heart disease (CHD). The use of CTA is likely to increase owing to its ability to rule out cardiac events in patients who are considered to be at low risk of developing significant CHD.

#### Balancing Radiation Benefits and Risks

Studies suggest that radiation exposure associated with CT has increased substantially over the past few decades. This increase in exposure needs to be curbed. It is important to analyse from patient studies when CT imaging is a great benefit and when radiation risks might be greater than the benefits expected. This would help avoid or minimise unnecessary exposures.

There are no large scale studies or research to prove cancer risks associated with radiation exposure from CT scan imaging. Risk estimates obtained from recent studies have been derived from research conducted on atomic-bomb survivors. Although the risk estimates obtained from these studies are small, the concern is that this might pose a threat in the long run with the increased use of CT, resulting in a public health issue in the years to come. It is important to weigh the risks and benefits and analyse, if the potential benefit is better than the potential risk. The key factor is appropriate utilisation because CT when used appropriately; the benefits of diagnostic information outweigh the potential risks by far. In order to mitigate dose exposure it is important to identify the fine line between controlled dose and acquiring sufficient information for an assured diagnosis.

#### SPECT, SPECT/CT and PET/CT

With improvement in the quality of SPECT imaging it is likely to remain the dominant perfusion imaging system. The latest developments in this sector have been with regard to reduction in scan time. GE has introduced Discovery NM 530c capable of reducing scan time from 15 to 20 minutes for each scan to three to five minutes. This SPECT cardiac imaging system uses a cadmium zinc telluride- based high-speed, high-resolution camera that not only reduces scan time but also radiation exposure. This technology represents a cost effective solution to diagnose

heart diseases.

Technological integration is likely to be a driver with the growing trend towards hybrid modalities. As a result, PET/CT and SPECT/CT systems are expected to witness positive growth. The advent of hybrid devices such as PET/CT, SPECT/CT, CTA (CT Angiography), which have CT as the cornerstone are likely to play a vital role in therapeutic intervention and oncology applications much more than cardiac. Owing to this, CT technology is likely to be at the forefront.

#### **Magnetic Resonance Imaging**

Cardiovascular MR (CMR) has a utilisation rate of 13 percent in the European regions and has been one of the most reliable modalities for myocardial infarction and cardiac ischaemia. It is also frequently used for the detection of cardiac tumours and CHD. CMR being a 4D high resolution imaging technique allows the evaluation of infarction and perfusion at the sub-endocardial level which may not be possible with other modalities. The modality offers a significant edge above cardiac catheterisation in detecting microvascular circulation changes and also in distinguishing atherosclerotic plaques from vulnerable plaques that could rupture easily causing myocardial infarction.

CMR also scores above nuclear imaging and ultrasound in the detection of valvular diseases in the right ventricle. Despite the several advantages that CMR has to offer above the other modalities, it is still sparingly used in European diagnostic settings owing to its high price and maintenance costs. Cardiovascular MR has evolved rapidly over the past ten years. High field 3T MRI permits microscopic resolution and near real – time 3D imaging. This along with tissue specific contrast agents will increasingly provide quantitative information. Technological advancements in cardiovascular MR are being driven by the need to overcome physiological constraints such as motion and blood flow.

Super paramagnetic iron oxide nano particles are likely to become the next generation of tissue specific contrast agents for MRI in another two years. One of the important developments in MR research has been the growing trend towards whole body ultra-high field systems. MR centres in Europe are investing in 7T MRI technology to realise the advantages and benefits of it in cardiac imaging. Recent cardiac studies performed with 7T provide detailed insights into cardiac anatomy. However 7T MR is not yet refined enough for use in cardiac applications as artifacts increase in proportion to field strength.

The MRI market constantly undergoes a technology upgrade through more sophisticated systems which have a negative impact on the sales of earlier systems. The mid field systems segment is by far the largest market and will continue to remain stable. The high field market is expected to experience a significant growth by 2015 while the ultra high market is expected to grow at a slower rate.

Low field systems are expected to witness a decline through 2015. 3T systems did not grow much in the recent past owing to issues with artifacts, patient comfort and versatility of use. However it has potential in the near future, if technical challenges and signal to noise ratio can be sorted out. 1.5T systems are expected to still have good years ahead as they are versatile, patient friendly and robust.

#### **Echocardiography**

The speed, safety and cost effectiveness of ultrasound gives it an edge above other imaging modalities. Echocardiography is usually the primary imaging procedure for cardiac diagnostics. Recent developments in ultrasound like 3D and 4D imaging have ensured good growth rates for this market. The latest advancements in this sector have been evaluating the structure of the heart and valve function. Technological advancements in 3D echocardiography allow a comprehensive analysis of the heart and all its aspects. There is continuous development of software applications such as 3D analysis of the atria, 3D quantification tools for valvular diseases and for 3D stress echo analysis.

Hand carried systems are gaining prominence globally with regions like Eastern Europe, Latin America and parts of Asia Pacific showing significant interest in this equipment. Radiological departments across the globe are replacing their cart based ultrasound systems with hand carried systems. Miniaturisation is a growing trend with hand carried ultrasound scanners being omnipresent and becoming smaller, faster and more affordable. Ultrasound equipment has a price advantage and even the most advanced ultrasound costs one-fifth of a basic MRI system.

Hospitals in Europe show a preference towards midrange ultrasound equipment. Ultrasound software for postprocessing images for enhanced analysis and dedicated probes are emerging to become the most important accessories for ultrasound equipment. Certain vendors are offering specialised ultrasound software that assist sonographers in interpreting the acquired image better.

#### **Cardiology Imaging Markets**

The market for cardiology imaging modalities is most certainly growing. With the increasing number of cardiovascular related diseases the utilisation rate of these diagnostic measures is bound to increase significantly. The cardiac imaging market is on a rise in Western Europe and also certain parts of Eastern Europe. China's healthcare sector is forecast to grow due to soaring demand and government support, which might seem appealing to private investors looking to invest in the market. China represents 40 percent of the world's population and growth of the world population is expected to result from these emerging market populations. China is likely to be one of the biggest global cardiac markets by 2015.

India also accounts for a major share in the world population. India's healthcare budget has gone up by nearly Rs.4,000 crore to Rs.21,113.33 crore (4.35 billion dollars) with the government expressing interest in rural healthcare. Healthcare organisations in India are looking to raise funds through private equity to invest in infrastructure and expansion plans. India also accounts for most of the diabetic patients.

Reimbursement continues to pose a threat to growth in the medical imaging market, and is an industry-wide constraint. Europe, as a diversified continent, has varied reimbursement policies: there is no common healthcare expenditure reimbursement policy as such. In addition, Europe offers very limited reimbursement for imaging procedures. Reimbursement levels are as low as 500 to 800 euros for MRI scans, which are high-cost procedures. The healthcare industry still continues to be bogged down by budgetary issues. European countries like Bulgaria have announced a 10 percent decrease in their healthcare budget for 2010. Ireland is also looking at implementing cuts of over one billion euros in healthcare in 2010.

The recession witnessed a decline in growth rates in the imaging sector in 2008 and 2009. Healthcare is becoming a costly affair across Europe with an increase in patient demand. Cost containment is expected to be the focus. The cardiac imaging IT area represents one of the quickest growth areas in terms of revenue. Despite pricing pressures, the large market potential provides a positive outlook for the next few years. Large volumes of data produced by multi-slice systems will greatly increase demand for technology that addresses data storage, 3D visualisation and analysis. Ties between PACS and advanced visualisation vendors are strengthening. Advanced visualisation integration with cardiovascular PACS is looked upon as a necessity these days and PACS vendors have made efforts to offer basic 3D functionality into PACS.

#### **Shifting Towards Safer Modalities**

With the increase in awareness about radiation exposure the market is shifting towards safer imaging modalities and therefore the ultrasound market will continue to grow robustly and echocardiography is predicted to see a significant growth in terms of utilisation. The future seems promising in terms of potential markets and developments in advanced technology, and the early quarters of 2011 are expected to see slow and positive growth. The U.S. and Europe will continue to remain key markets while Asia, China and Japan are also recognised as potential markets. Technological integration is likely to be a driver with the advent of integration of positron emission tomography (PET) and magnetic resonance imaging (MRI). MRI and CT markets are expected to see a modest growth through to 2015. Resurgence is expected in medical imaging with a rise in utilisation and healthcare reformation. Demand for high tech imaging and a need for replacement systems will result in a rise for MRI scanners, particularly the 1.5 T and 3T segment.

Published on : Wed, 15 Dec 2010