Prince of Wales Hospital
The Chinese University of Hong Kong

Cardiac Surgery Report

2012

Division of Cardiothoracic Surgery
Department of Surgery

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Foreword

Hong Kong takes pride in its public healthcare system of high quality and efficiency. The Division of Cardiothoracic Surgery of the Prince of Wales Hospital has always been one of the most outstanding and innovative surgical unit in Hong Kong. The surgical results presented in the Report are solid testament of the Prince of Wales Hospital's competence in and commitment to quality. The outcomes of Coronary Artery Bypass Graft surgery have been excellent. The achievements in shortening waiting time, maintenance of low mortality rate and reduction in bleeding incidence are also encouraging.

I commend the transparent practice of the Report, which will be made available in the public domain for scrutiny. This not only is a timely response to the rising public demand on transparency, but also demonstrates the Princes of Wales Hospital's staunch dedication to public accountability. We are in an era where there is increasing awareness on the "quest for quality", as well as regulation of healthcare industry. The Prince of Wales Hospital's initiation in conducting and

publishing audit of the surgical results is exemplary to continual quality improvement, which will undoubtedly shed light on future development of services in the Hospital Authority as a whole.

Last but not least, I would like to express my heartfelt appreciation to healthcare professionals who have made unswerving devotion in the field of cardiothoracic surgery in the past years. I would also like to congratulate the Prince of Wales Hospital on its success in the publication of the Report. I am confident that the Hospital will continue to scale new heights in its future endeavour.

Dr KO Wing-man,
BBS, JP
Secretary for Food and Health

Introduction

This is the fifth report for the Division of Cardiac Surgery, Chinese University of Hong Kong, Prince of Wales Hospital, Shatin, New Territories, Hong Kong.

We began data collection as part of a quality assurance programme for patients undergoing cardiac surgery in our Institute from November 2005. Since that time we have moved purposefully from basic outcome analysis described in the first report in 2006 to comprehensive 'international benchmarking' with the Society for Cardiothoracic Surgery in the United Kingdom and the European Society of Cardiothoracic Surgery documented in the 2009 and 2010 publications. This endeavour also highlighted the value of moves towards 'global' benchmarking for cardiac surgical activity and outcomes (1, 2). In this current report, we again highlight our trend towards 'real-time' monitoring of mortality, morbidity and other areas of quality provision. Our goal has always been public transparency and again this report is published and is freely available on the internet (3).

http://www.surgery.cuhk.edu.hk/surgical-audit/

Our data collection, methodology and principles have essentially remained unchanged but we now only have a single research person who contributes to data collection, validation of data accuracy and database maintenance. Our underlying principle has always been that to have a usable database, fit for purpose, particularly for 'real time ' monitoring, the most accurate data is collected at the point of patient care and it is the professional responsibility of all individuals engaged in providing such care to ensure this is done. Unfortunately, in the current climate and struggling with manpower issues as many public hospitals in Hong Kong, it has been a challenge to maintain this commitment. However, as detailed later, after checking data accuracy and validity prior to extraction and analysis for this years report we can be pleased that it continues to be of the highest standard. It is

remarkable that having only commenced data collection in 2006, we now have over 2,000 patient records available for analysis, an invaluable resource to document our changing clinical environment and its associated implications for the provision of cardiac surgical care by our Department.

In terms of clinical activity our patient population continues to progressively change. The risk of the patients we are operating on has increased for a sixth consecutive year. A constant change has been the increase in patients referred for urgent and emergency surgery. In the last two years, the number of cases undertaken on an urgent basis has again increased. There continue to be changes in the complexity of operations undertaken with significant increases in the number of double and triple valvular operations and a maintained increase in the number of re-operative and combined surgeries. This again has implication for future resource usage and service provision. In past reports we have excluded patients who underwent complex endovascular interventions on the aorta but with increasing numbers these patients and this intervention have become a significant part of our Aortic Programme and they are now included in all our analysis.

We were delighted at the end of 2010 to move into new facilities at the Prince of Wales Hospital. We now work from a 39 bed integrated cardiothoracic ward with 6 high-dependency beds. The new infrastructure has also given us access to 2 cardiac theatres; one is in the process of being converted into a 'state of the art' hybrid theatre to ensure we can provide minimally invasive and innovative treatment for patients with cardiac disease into the next decade. The project has been funded by an anonymous donor to whom we are deeply grateful. Towards the end of 2011 we were also granted access to an additional days operating for cardiac surgery which gives us four full days a week. In reality this becomes five as we struggle to cope

with our ever expanding waiting list and influx of urgent cases. The support of nursing, perfusion, intensive care and anaesthesia can not be overestimated as we strive to maximise our resource allocation and provide timely and quality service.

Despite all our efforts and attempts to maximise our case-load we still have a significant number of patients waiting for cardiac surgery. Addressing this is now not so much a problem of facility, but resource in terms of medical, nursing and ancillary personnel. With the manpower issues which have been so well documented in the local media it is unlikely that this situation will change significantly in the near future.
It has become apparent over time however that there is an 'elephant' in the room.

In general terms we can estimate the number of cardiac operations per million populations which one would expect to perform if providing a service which meets the required needs.

Obviously this number can vary greatly globally but if we take the United Kingdom (UK) as an example, from the latest data, approaching 40,000 cardiac operations are undertaken annually which equates to around 650 cardiac operations/million population per year. If we calculate the same figure for coronary revascularisation operations (CABG) in the UK it is around 25,000 surgeries per year or 400 operations per million populations per year. Comparative figures for Hong Kong are currently a total of 1,500 cardiac cases per annum (data from all 3 cardiac units) which equates to 214 cases/million population per year. For coronary surgery this number would be 86 cases/million population per year. That figure for our Department, serving the New Territories is 73 coronary revascularisations per million populations per year. We know if anything, the risk profile of the Hong Kong population

is similar if not slightly worse in terms of coronary risk factors than the UK and the percentage of valvular cases locally is higher due to the residual impact of rheumatic heart disease in the region.

However we analyse it, there seems to be a gross under-provision of cardiac surgery for our local population. The reasons for this are most likely multi-factorial and may relate to access to primary care, cultural issues and perceptions of cardiac surgical safety and outcomes, follow-up facility after attending accident and emergency with chest pains etc. There are many challenges to face to ensure we can provide a prompt, high quality and numerically significant cardiac surgical service for our local population. The importance of collecting and collating accurate data so we can monitor activity and outcomes has never been clearer.

Professor MJ Underwood,
MB ChB, FRCS(Ed), FRCS(CTh), MD, FCSHK.
Chief, Division of Cardiothoracic Surgery
Department of Surgery
The Chinese University of Hong Kong
Prince of Wales Hospital, Shatin, NT
Hong Kong
Email: mjunderwood@surgery.cuhk.edu.hk
Tel: (852) 2632 2629
Fax: (852) 2637 7974

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1. The Division of Cardiothoracic Surgery

The Division of Cardiothoracic Surgery, the Chinese University of Hong Kong (CUHK) is based at the Prince of Wales Hospital (PWH), an acute regional hospital as well as the teaching hospital associated with CUHK. It is situated in the New Territories and hosts the Regional Trauma Centre as well as other acute surgical specialties. The Division of Cardiothoracic Surgery provides complete services within the specialty for a population of approximately 2.2 million people, excluding paediatric cardiac surgery, cardiac transplantation and esophageal surgery.

Within the Division of Cardiothoracic Surgery there are now 39 designated beds in ward 7C (Level 7, New Build PWH). Ward 7C provides exclusive use of 6 High-Dependency beds for cardiac surgery. The Intensive Care Unit (ICU) is located on Level 5 adjacent to the operating suite. 2 beds on intensive care are for the exclusive use of cardiac surgery patients for four days per week. To maintain our level of activity however there needs to be close co-operation with colleagues in intensive care to allow flexibility in this arrangement. Cardiac surgical patients are looked after by accredited intensivists whilst on ICU with surgical input where appropriate. Patients transferred from ICU to the HDU are looked after by the cardiac surgical team with input from other support specialties when requested. We have one dedicated theatre solely for the purpose of cardiac surgery which is currently funded for use 4 days a week. A pre-operative cardiac assessment clinic is currently held on alternate weeks. An additional cardiac theatre is in preparation as a 'hybrid' theatre following the kind donation of funds from a private source to sponsor this. This is anticipated to be operational by early 2013. An increase in associated resource would also be required however in order to maximise use of these facilities and increase output whilst maintaining efficiency.

2. Outcome Reporting

The outcomes presented in this report have again been 'benchmarked' against the national cardiac surgical database report from the United Kingdom (UK) (United Kingdom Cardiac Surgical Register, UKCSR) (4). We recognize that the populations treated may be inherently different but interestingly the pre-operative risk profiles are very similar and the UK publication remains one of the most authoritative and comprehensive documentations of national cardiac surgical practice available anywhere worldwide and as such has been used here as the 'gold standard' for comparison. It is also the most current source of international cardiac surgical activity.

In our report we have also used our own 'risk-adjusted' data and reported 'observed' versus 'expected' outcomes. We have focused on cumulative activity over 6 years with highlights of the last twenty four month activity. We have also looked at yearly trends and also made comparisons between cumulative data for the years 06/07 and 10/11.

3. Overall Cardiac Surgical Activity.

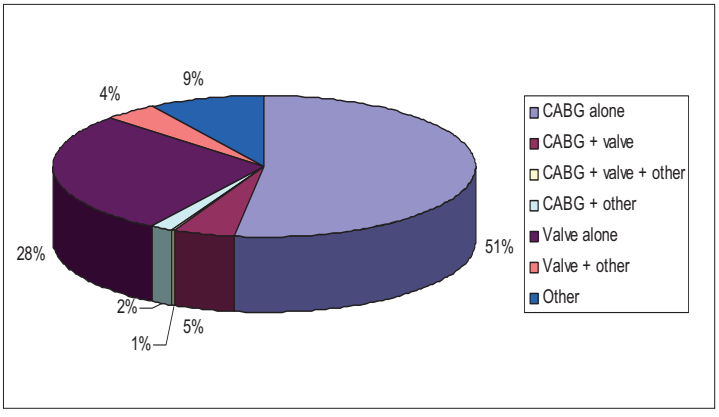


Figure 1. Distribution of Cardiac Procedures 2006-2011

During the last twenty four months of activity 683 patients had cardiac surgical procedures in our institution. This means that over the last six year period we have a total of 1949 patients accumulated in the database. Figure 1 shows the relevant percentages of the operations by type for the cumulative period. Patients with descending aortic disease have previously been excluded from this analysis but with increasing activity have been included in part from 2010 and completely from 2011 onwards.

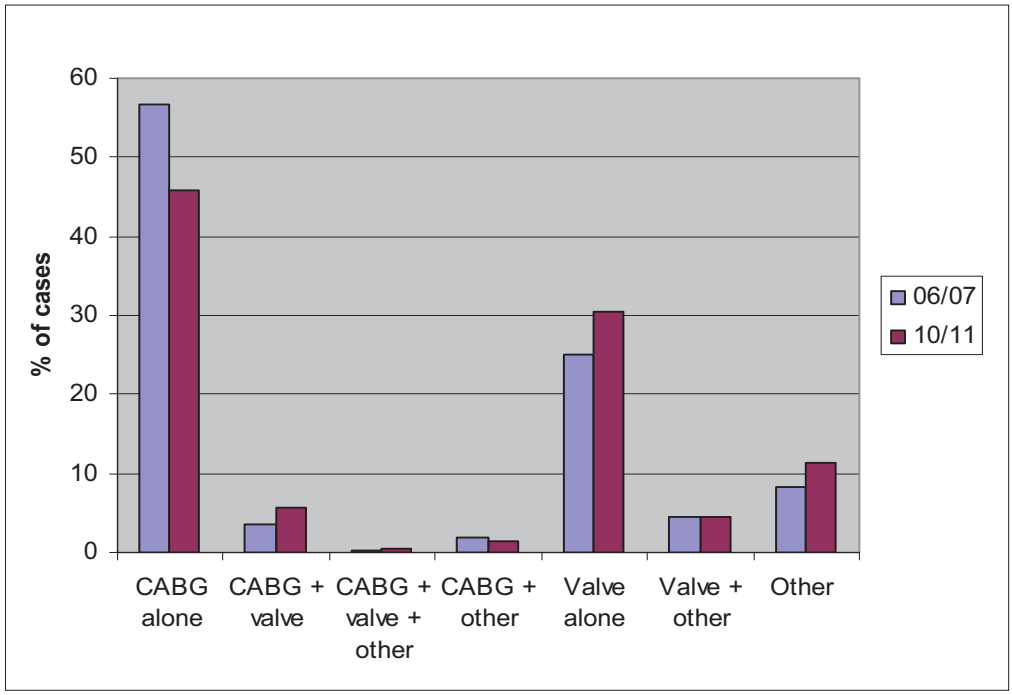


Figure 2. Change in Type of Cardiac Procedure Over Time

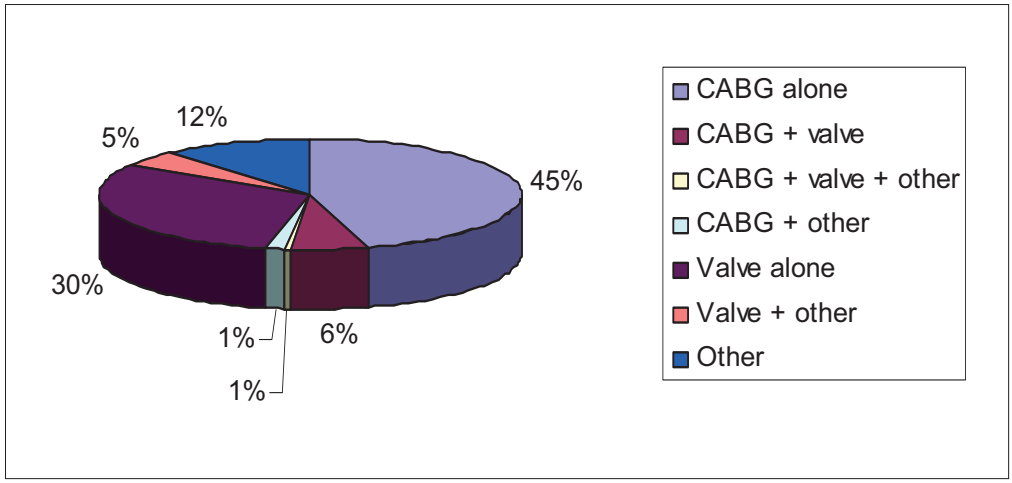


Figure 3. Cardiac Procedures 2010/2011

There have been changes in our local case-load over time as shown in Figure 2 with slight reductions in the proportion of patients undergoing isolated coronary surgery and increases in valvular surgical procedures and also our category of 'other' which mainly represents our aortic work. Figure 3 shows distribution of procedures for the years 2010 and 2011. We can see that for the first time coronary revascularisation is now less than 50% of our workload and aortic procedures (categorised as 'other') now make up over 12% of out activity.

Figure 4. Changes in Operative Priority

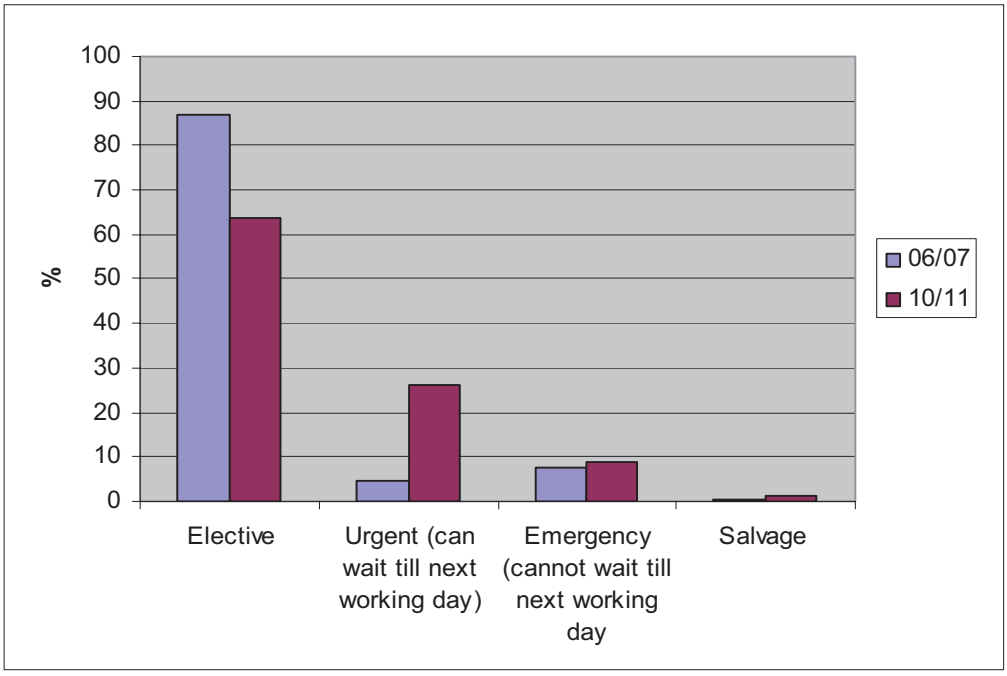
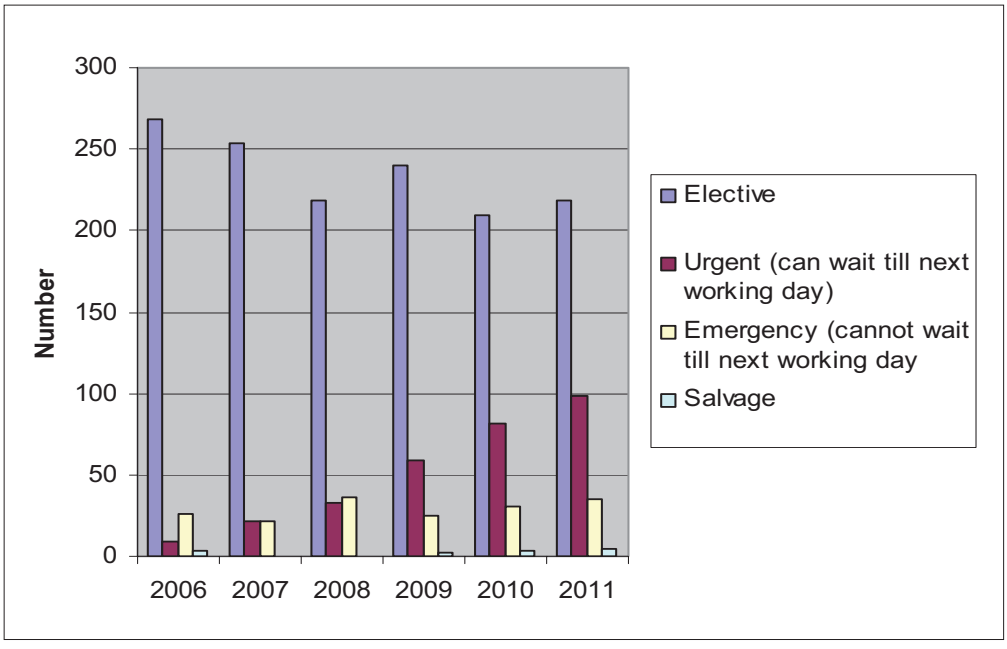


Figure 5. Change in Operative Priority Over Time



There has been a reduction over time of patients undergoing elective surgery and an increase in patients who require urgent and emergency operations (Figures 4 compares data for 06/07 with 10/11, Figure 5 shows yearly trends) which we have commented upon previously. Last year, 39% of cases were urgent or emergency and this has had serious resource and organisational impact on the Division.

All case mortality (defined as death during the same hospital admission) for the six year period was 3.3 % for all surgical activity (63 deaths) and 1.3 % for isolated coronary artery bypass surgery (CABG) (13 deaths). There were no differences in annual crude or risk-adjusted mortality rates for either group. These outcomes compare favourably with non-risk adjusted crude mortality figures from the UK (UKCSR, all cases 3.5%, isolated CABG 1.5%). There has been no significant change year on year.

In terms of valve operations over the six year period, Figure 6 shows the distribution of procedures performed. A significant number of patients underwent double valve replacement, usually for rheumatic disease and increasing numbers required a triple valve procedure. Figure 7 shows the nature of the valve pathologies we saw in our group of patients; an interesting feature is the increase in numbers of patients operated upon for degenerative or functional mitral valve disease which may reflect the Divisions efforts in establishing a mitral repair service in conjunction with colleagues in Cardiology who now provide routine 3D echo imaging.

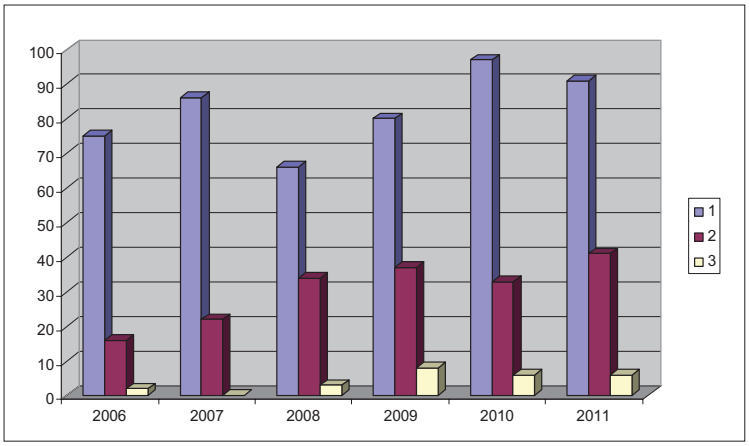


Figure 6. Number of Valves Repaired and Replaced

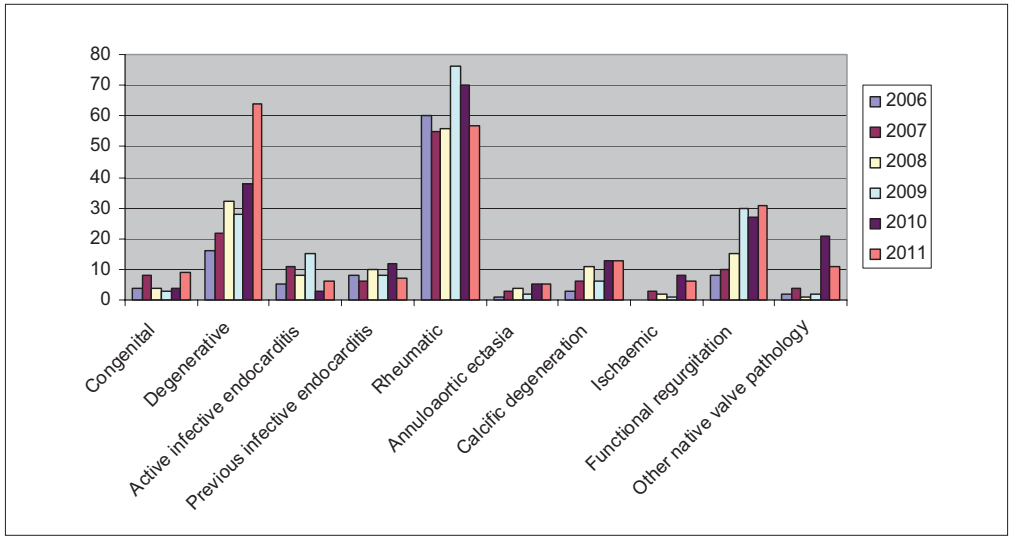
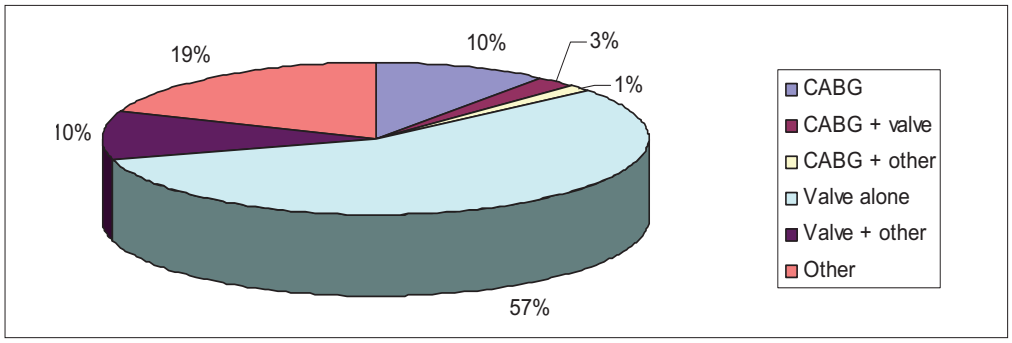


Figure 7. Valve Pathology Over Time

Figure 8.Re-Operative Procedures



A total of 64 patients underwent re-operative cardiac surgery (5 patients had a third cardiac operation, and 2 patients a fourth), 3.2% of the total workload but numbers show a five fold increase over the last two years. This, as we have mentioned before is fitting with the development of the Unit, which has been performing open-heart surgery for nearly 10 years now, the time when re-operation becomes required with increasing frequency (Figure 8).

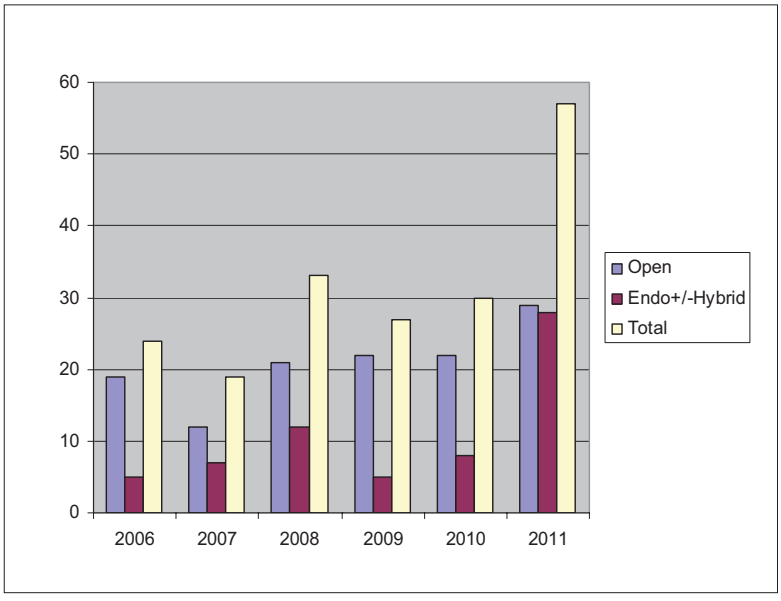


Figure 9. Interventions on The Aorta

Activity for surgery of the ascending aorta +/- aortic arch has also increased along with our endovascular stenting programme with collaboration with colleagues in vascular surgery and radiology (Figure 9). One hundred and fifty four cases in total have been performed with 19 deaths (12.3%, UKCSR 12.9%). 75% of these cases were emergencies for acute Type A aortic dissection and 5 were 'salvage' surgeries. 15 patients underwent re-operative aortic surgery and 2 patients a 3rd operation hence it represents a heterogeneous group of patients with high risk. The mortality for patients undergoing emergency intervention for acute dissection in 2011 was 9.0%.

4. Waiting Lists for Cardiac Surgery, Referral Patterns and Length of Stay

Figure 10 shows the centres we provide a service for and their contribution to our workload. There was no major change in pattern of referral over the six year period. Our current waiting list stands at over 180 patients, the longest in Hong Kong. With the increase in referral of emergency and urgent in-hospital cases provision of 'elective' surgery within the current resource limitations is difficult. We are currently, at a national level looking at this issue, its implications and resolution. We have also documented some differences in the pre-operative patient risk profiles according to referral centre (Figure 11).

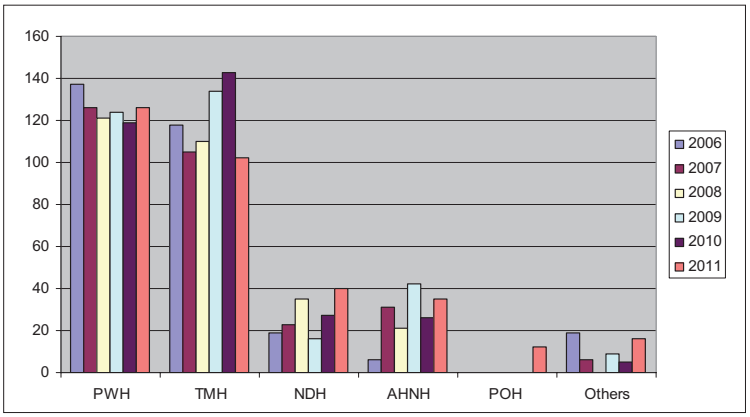


Figure 10. Referral Patterns

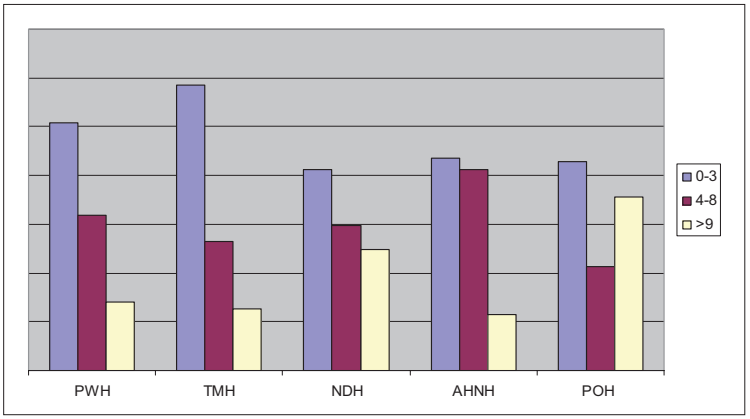


Figure 11. Risk-Adjusted Referral Patterns (% of patients in logistic EuroSCORE category)

We benchmarked our length of hospital stay in the previous report using the European Association project in which our data was independently aggregated. (Figure 12)

Length of stay has been purported as a measure of 'quality', in other words the shorter the postoperative stay the inference is

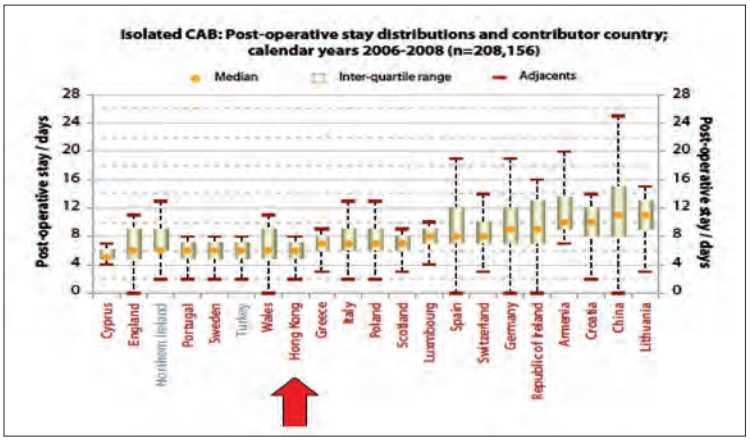


Figure 12: CABG Post-Op Stay

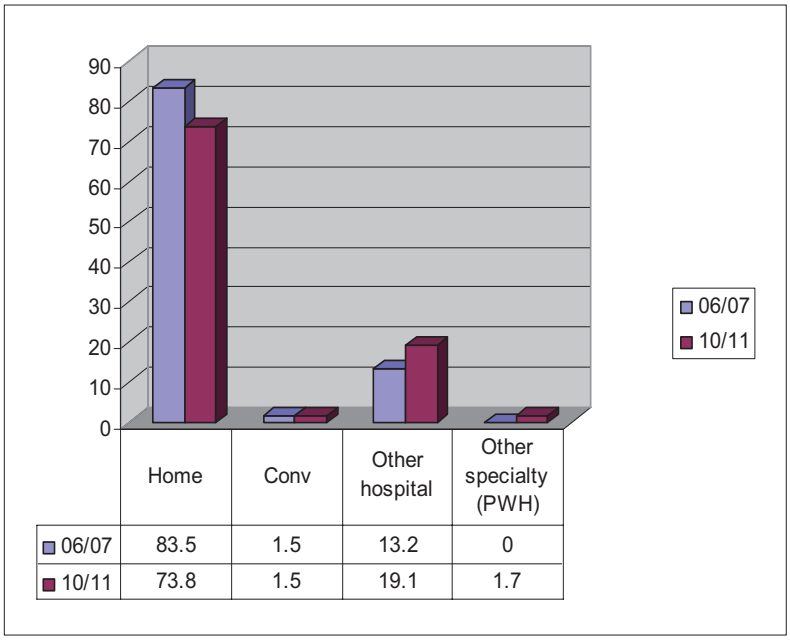


Figure 13. Discharge Destination (numbers are percentages, conv = convalescence)

the smoother the post-operative course and the occurrence of fewer complications. Cardiac surgery is more complex than this however and many Units transfer patients to additional care facilities or the local refereeing hospital for convalescence. This implies their measured post-operative stay is short but may not reflect the total hospitalisation time for the patients. Figure 13 shows the destination of our patients after discharge from our Cardiothoracic Unit. We have very little facility for patients to be discharged to convalescent places and the ability for them to be transferred back to refereeing facilities is also limited so we can see the majority of our patients stay with us until they are fit for discharge directly home. Despite this, our post-operative lengths of stay are impressively low.

5. Patient Demographics

Sixty nine percent (69%) of patients were male, 31% female. Mean patient age was 61 years (range 19-87) which has been reasonably consistent over the six year period but in the last 12 months we have seen significant increases in the number of patients over the age of 70 and also those into their eighth decade. In our last report we mentioned that in Hong Kong this recorded age may not reflect the 'true' age of the patient, many of whom may actually be chronologically older than stated on their official record. This remains an important consideration when advancing age has a major influence on operative risk and is an important component of many of our risk-stratification models.

6. Risk-Stratification and Presentation of Outcome

Introduction

A detailed discussion of risk stratification and outcome analysis can be found in our previous reports and also the first UK Society 'Blue Book' (3,4). We have continued to use the logistic EuroSCORE as our risk model for overall surgical activity (Appendix 1). We do this however; with the recognition that there is continued 'drift' in its accuracy and it is currently being re-evaluated in a venture by the EuroSCORE group. At present an updated EuroSCORE 2 is being evaluated to assess performance and it might well be we adopt this in the future if it is validated and calibrated for our population. With this in mind we have also presented some outcomes which have used the re-calibrated EuroSCORE (based upon the UK population). As for our previous reports we have used a variety of graphical means to depict outcome, each having its own merits.

Risk Profiling

Before presenting mortality as a risk-adjusted outcome it is useful to have some idea of the 'spread' of patients within the variously designated risk groups. For comparison over the last four years we have used the logistic EuroSCORE and found the mean score for our population has increased from 5.35 to 7.45. We can see in Figure 14 that this reflects a consistent reduction in the number of patients in the lower risk group and an increase in the number of patients scoring as high (4-8) and very high (>9) risk. This has been a universal finding in

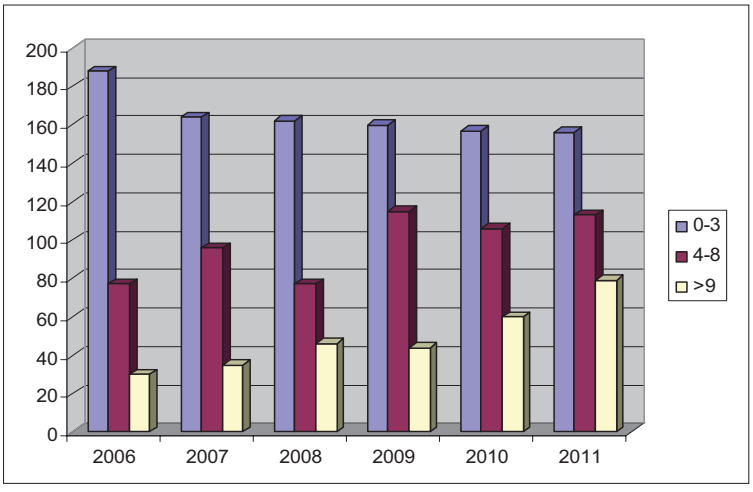


Figure 14. Change in EuroSCORE Values Over Time

international cardiac surgical practice and in our Division represents we believe a true reflection of the changing workload.

Outcome Presentation: Mortality

We have presented overall outcome data (mortality) in our usual graphical formats.

1) Comparative to the UK in the format of 'funnel' plots which provide a strong visual indication of any divergent performance or specific cause variation.

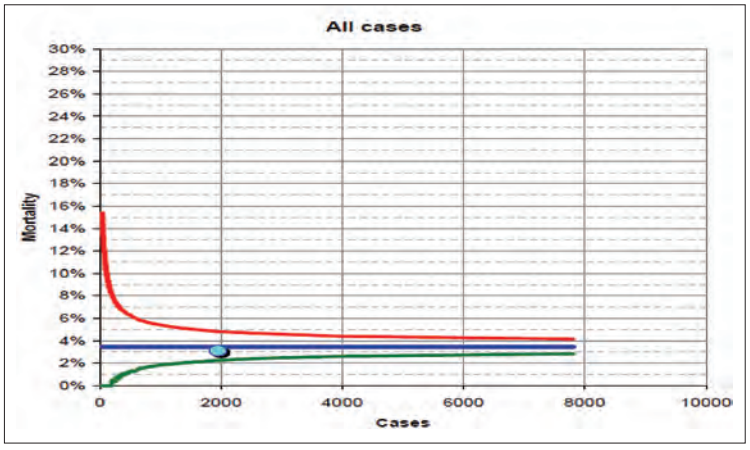


Figure 15. Funnel Plot of Mortality (All Cases)

For this report, we have used the plot generated using the EuroSCORE as the risk-model accessed via the SCTS UK website. The control limits refer to those generated by submission of data from all cardiac units in the UK to the SCTS, mortality (light blue dot) represents PWH data within these control limits. Comparative graphs were also published in our last report . This is demonstrated in Figure 15 and represents all cardiac surgical activity for the 6 year period.

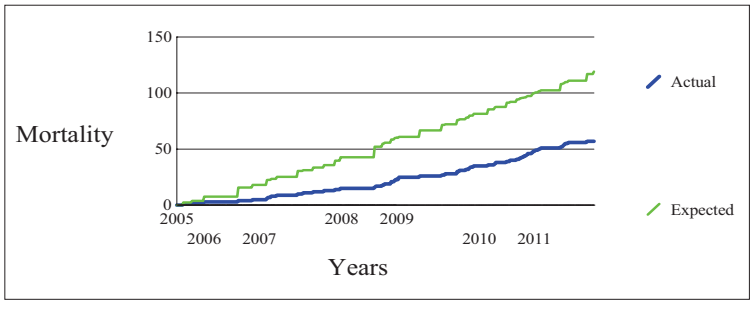


Figure 16. Mortality RA-CUSUMChart (versus logistic EuroSCORE)

2) As a plot of cumulative events against time (CUSUM chart plot). To incorporate adjustment for risk the statistical analysis is complex and utilizes odds ratio's to produce risk-adjusted CUSUM charts (RA-CUSUM). This provides a clear graphical depiction of risk-adjusted performance over time with comparative 'observed' versus 'expected' outcomes.

Figure 16 shows our RA-CUSUM plot for all cases over the six year

period, again using the logistic EuroSCORE as our predictive tool. We should note however that with the potential change in the applicability of the risk model, most competent cardiac surgical units reporting data using this tool are performing better than predicted

3) As presented publicly for UK cardiac surgery by the UK Healthcare Commission, now Quality Care Commission. Explained simply, the chosen risk scoring system is used to generate a percentage range of patients who would be 'expected' to survive taking into account their specific risk factors. This is indicated by the '2' in Figure 17. This range can then be plotted along with the 'observed' survival for that patient group, indicated by the '1' in Figure 17. If the 'observed' survival percentage falls anywhere within the 'expected' survival range then we can suppose that this reflects entirely adequate performance with respect to the calculated risk profile of that patient group. An 'observed' survival percentage that falls to the left of the 'expected' range (towards the 70 mark) would indicate a worse outcome than that predicted by the risk scoring system and an 'observed' survival percentage which falls outside the 'expected' range to the right hand side (towards the 100 mark) indicates better than predicted performance.

Figure 17 shows the chart plot for our cumulative six year data for all patient groups.

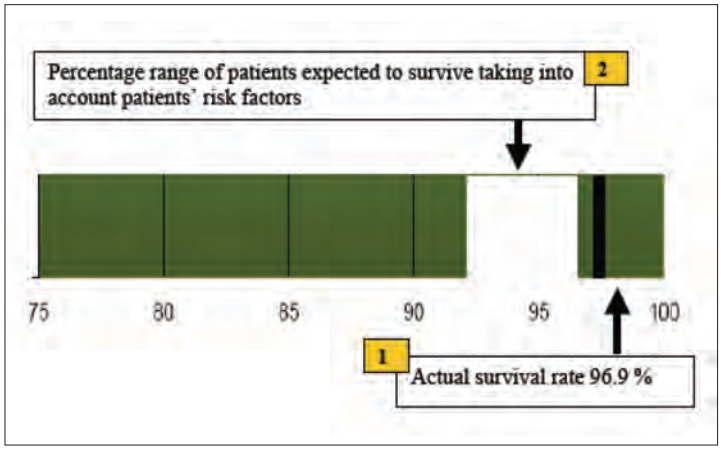
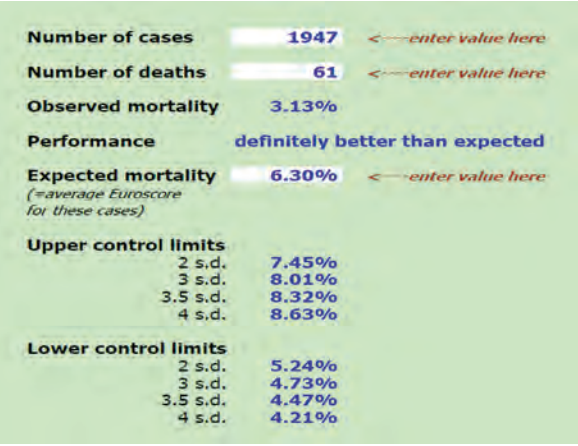


Fig 17. Observed versus Expected Mortality

In essence, all these methods demonstrate the same outcomes but in slightly different ways and we have used all three in previous reports. We can be reassured that our performance is currently better than expected when using risk modelling for our local patient population and comparable to international standards set in the UK using re-calibrated scoring systems.



Number of cases	1947	<---enter value here
Number of deaths	61	<---enter value here
Observed mortality	3.13%	
Performance	definitely better than expected	
Expected mortality (=average Euroscore for these cases)	6.30%	<---enter value here
Upper control limits		
2 s.d.	7.45%	
3 s.d.	8.01%	
3.5 s.d.	8.32%	
4 s.d.	8.63%	
Lower control limits		
2 s.d.	5.24%	
3 s.d.	4.73%	
3.5 s.d.	4.47%	
4 s.d.	4.21%	

Figure 18. Control-Limit Calculator: All Cases

The graphical presentations suggest visually better than expected outcomes in comparison with expected but to substantiate this requires some statistical analysis and the knowledge of the standard deviations. The statistical analysis is beyond the scope of this report but if we put our data of observed and expected outcomes into a control limit calculator we can see that it further substantiates the suggestion that we are definitely performing better than our risk scores predicts (Figure 18).This has to be taken into context in that this information is only as robust as the risk scoring system but it provides an additional mechanism to help interpret our data.

Outcome Presentation: Morbidity

As well as the presentation of outcome in the form of mortality, it is important to recognize that a 'poor' outcome not only includes death, but also a variety of events which may lead to significant morbidity and be detrimental for the patient. It is difficult to collect data on every single possible complication and in cardiac surgery a number of outcomes are used as 'markers' of morbidity.

These are: re-operation for haemorrhage, permanent stroke, need for new dialysis post-operatively and surgery for deep mediastinal wound infection. In Table 1 we have indicated crude percentage occurrence for all morbidities for the full six year period of our activity. We have however seen significant changes in occurrence of morbidity over time, for example, if we compare the need for new dialysis in the postoperative period in 06/07 it has increased from 0.3% to 5.6% in the years 10/11. This we believe reflects the increase in the pre-operative risk of the patients we are now taking on for surgery but is something we will continue to monitor.

All crude figures fall well within expected and reported international standards.

7. Bleeding and Transfusion

As mentioned in previous reports, we have chosen the area of re-operation for bleeding, blood transfusion and blood loss for detailed investigation since they represent important areas of potential morbidity for an individual patient. Another reason is that re-operation rates for bleeding can potentially be used as 'quality' indicators and we can easily compare our outcomes in graphical form as a CUSUM chart, with comparative indices taken as 'fixed' values from international data. For example, Figure 19 shows the CUSUM chart for re-operation for bleeding with the reported UK figure of 5% (estimated) set as the 'gold-standard' for comparison for our activity during in the last 6 years.

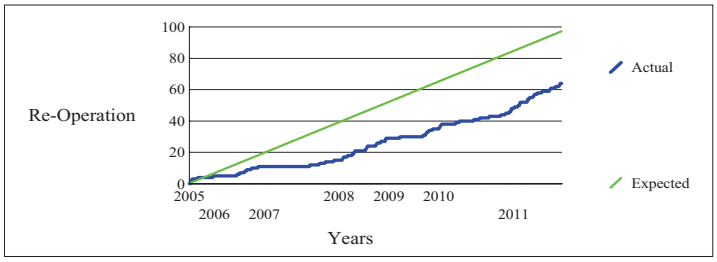
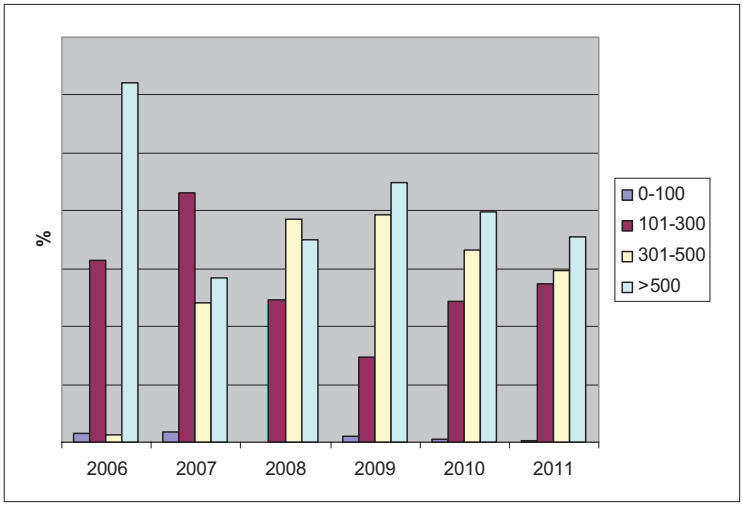


Figure 19.Re-operation for Bleeding

In the last report we noted an increase rate of blood loss and thought it could be explained by a variety of factors including the increase risk profile of the patient population, the increase in number of patients presenting for urgent operation whilst still on anti-platelet and anti-coagulant drugs and the increase in re-operative surgery. We also wondered whether the withdrawal of aprotinin (a haemostatic agent) which we previously used in 'high risk' cases may also have had an impact. Our re-operation rate for bleeding as shown is well within acceptable limits but again we wanted to monitor aspects of blood loss for this current report. Figure 20 shows our cumulative data over time according to blood loss in the first 24hrs after surgery.

Figure 20. Blood Loss Over Time



We can see that the dramatic reduction achieved from 2006 to

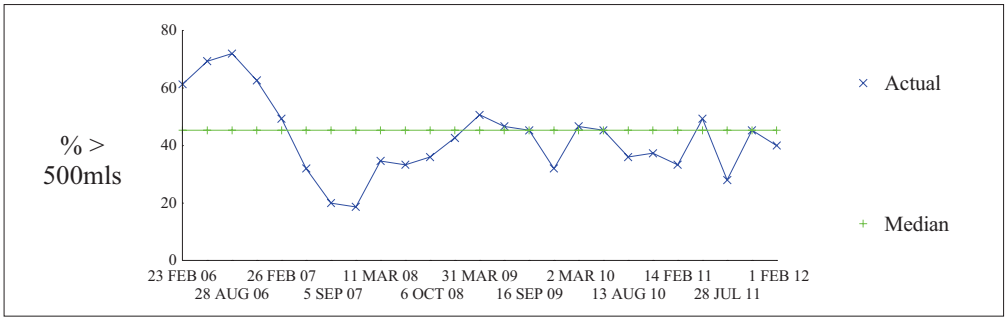


Figure 21. Chest Drainage: Trends 2006-2011

2007 has not been maintained but there have been small improvements in the last 2 years, certainly not an increasing trend. We believe it does reflect genuine changes in pre-operative risk but we continue to monitor this closely and we do on a 3 monthly basis 'real time' using our 'runs analysis' programme (Figure 21).

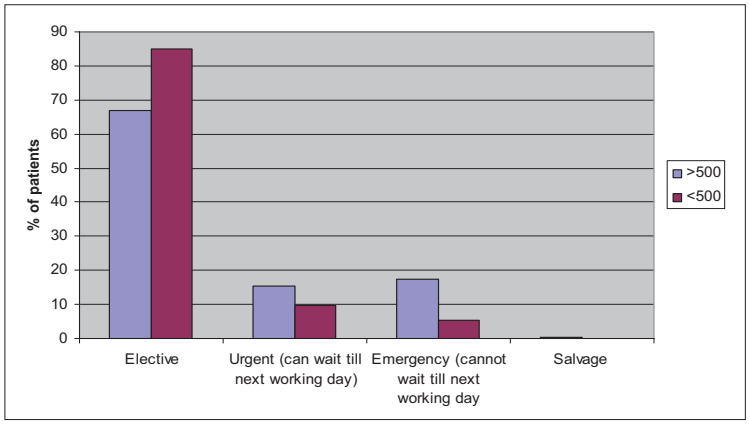


Figure 22. Blood Loss Grouped by Operative Category

As described previously it seems more likely in urgent and emergency cases and also in more 'complex' procedures such as aortic surgery and combined coronary and valve operations Figure 22 , which have increased in incidence in our practice. Also, further investigation has shown that the patients likely to bleed the most are (as suspected) on pre-operative tablets or infusions of drugs which increase the risk of bleeding following surgery (Figure 23 and 24). As we have noted before with an increase in urgent surgeries,

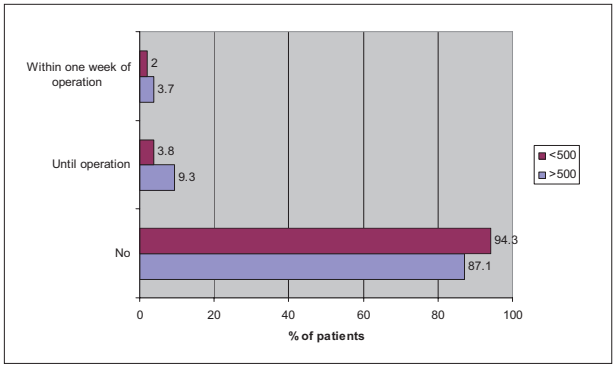


Figure 23: Heparin and Blood Loss

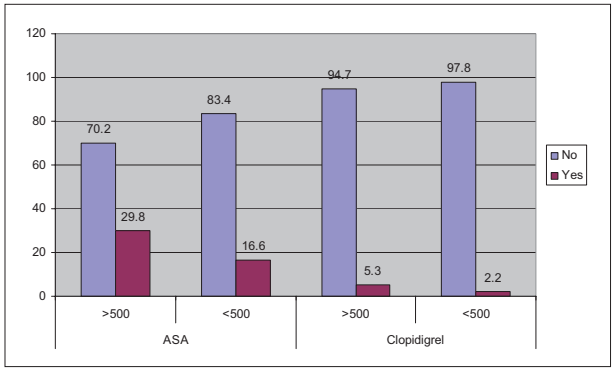


Figure 24:Aspirin and Clopidigrel and Blood Loss

many patients do now need to be treated with these drugs to reduce their risks of a myocardial event prior to operation and again is a surrogate reflection of the changing population. This is an area we will continue to focus on.

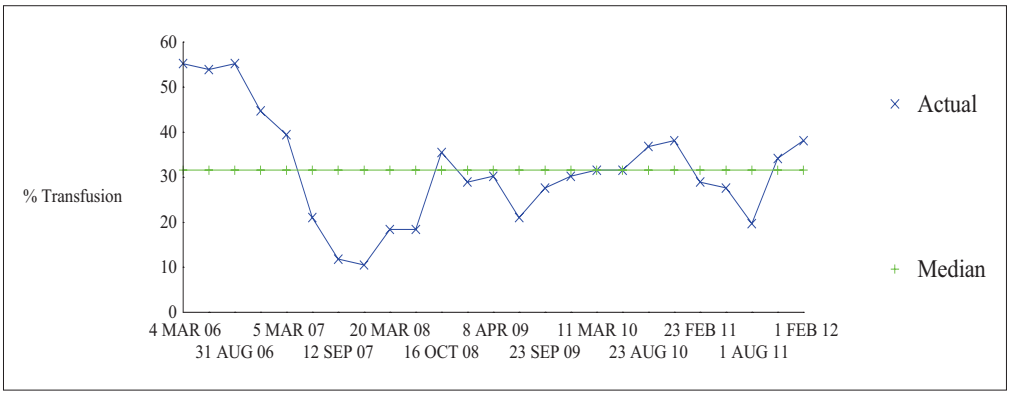


Figure 25. Blood Transfusion: Trends 2006-2011

We have looked closely at our blood transfusion practice over the last six years and we can see that the reduction in red cell transfusion previously reported has been sustained in the ICU (Figure 25) but with the changing patient population it is doubtful we can ever replicate the massive reduction in transfusion achieved in 2007. We have looked at this in context of the blood loss groups mentioned above and found the reduction in transfusion is seen in both the 'high' loss (>500mls/24hrs) and 'low' loss groups (<500mls/24hrs) (Figure26:

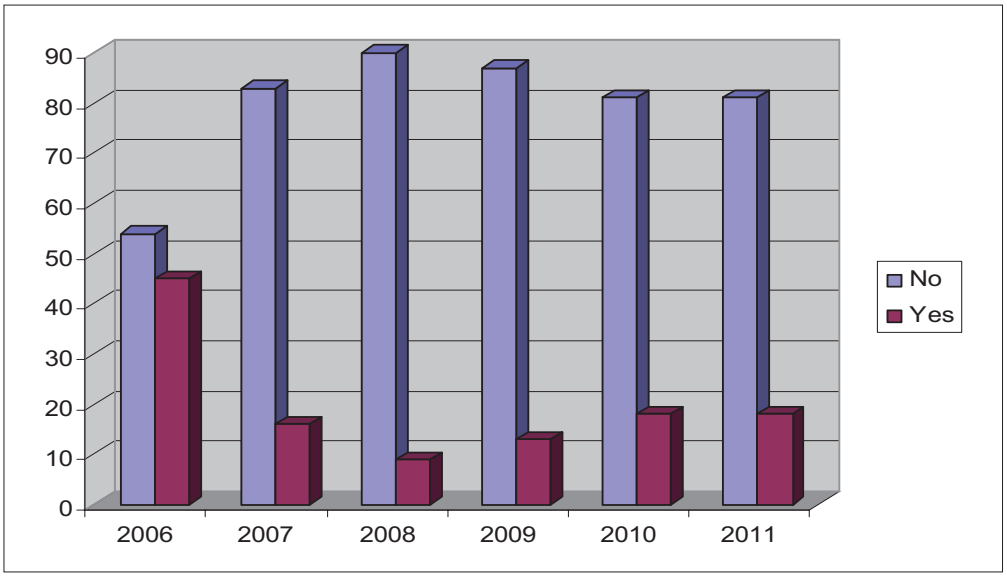


Figure 26: Transfusion in patients with 'low' blood loss on ICU

low blood loss group). It seems intuitive that if a patient does not loose much blood post-operatively then the transfusion rates should be zero but it is a much more complex issue with many variable and we use this group to monitor practice and note the changes which may require multidisciplinary intervention. Transfusion of blood products such as fresh frozen plasma and platelets has mirrored red cell transfusion practices.

8. Valvular Surgery

We have used our six year data to look at our valvular surgery in more detail.

Mitral Valve Disease

We see a preponderance of mitral valve disease due to the residual impact of rheumatic valve disease in the region (Figure 27). Overall rheumatic disease accounted for nearly 60% of mitral interventions (30% in the UK). However not only we have seen an increase in the number of patients referred for mitral surgery but also significant changes in pathology with increasing numbers of patients being seen with degenerative and ischemic pathologies (Figure 28). This is an interesting trend towards a more 'Western' disease profile.

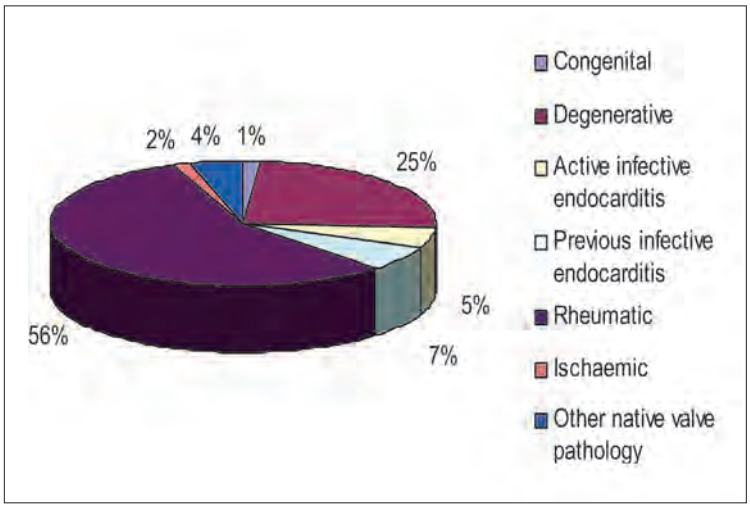


Figure 27.Mitral Valve Pathology

Patients undergoing mitral surgery presented in NYHA Class III or IV in 45% of cases overall (Figure 29).6% of this patient group were undergoing re-operative surgery. Of 148 patients with 'pure' mitral regurgitation 108 underwent valve repair (73%). In patients undergoing mitral valve replacement almost universally a mechanical prosthesis was

used (92%) reflecting the young age of the population and the concomitant indications for warfarin therapy for example the presence of atrial fibrillation which occurred in 72% of this patient group.32% of this patient group required associated intervention on the tricuspid valve, usually an annuloplasty ring and Figure 30 shows that this has increased significantly over time. This probably reflects an international 'trend' of more liberal intervention in patients with associated tricuspid regurgitation and annular dilatation.

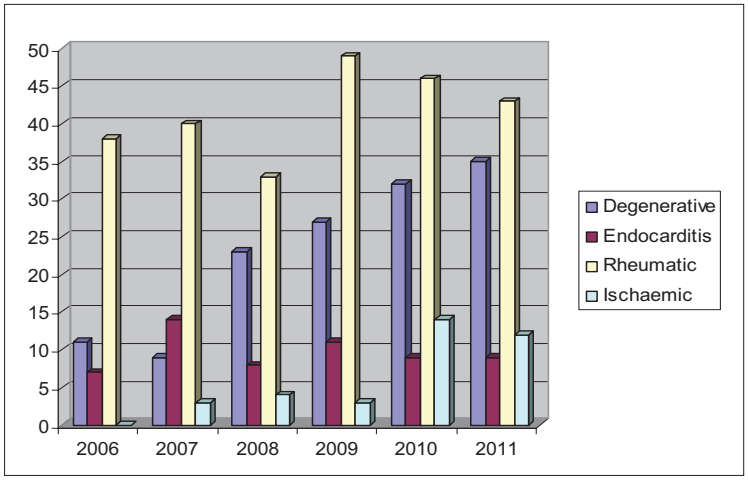


Figure 28. Changes in Mitral Pathology Over Time

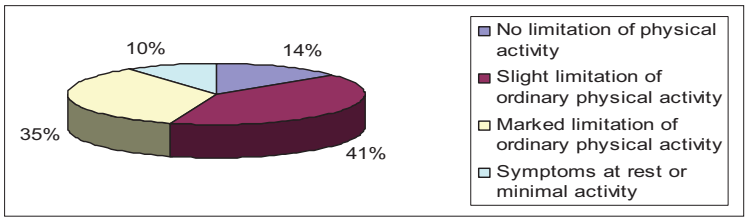


Figure 29. Pre-operative Symptoms

Aortic Valve Disease

Along with coronary artery bypass grafting, isolated aortic valve replacement has been considered as a 'marker' operation for monitoring outcomes. 244 isolated aortic valve procedures were performed in out Unit with 6 deaths (2.4%) and a mean logistic EuroSCORE of 5.5 for this patient population. UK mortality was 3.8% for comparative groups. As previously, mortality for this period was plotted on a funnel plot and control limits set using current UK data. This is shown in Figure 31. This plot which we have used before is for clarity only as it has been plotted using UK data based on valvular surgery from 2004-5 but as mentioned before it does illustrate along some of the advantages and

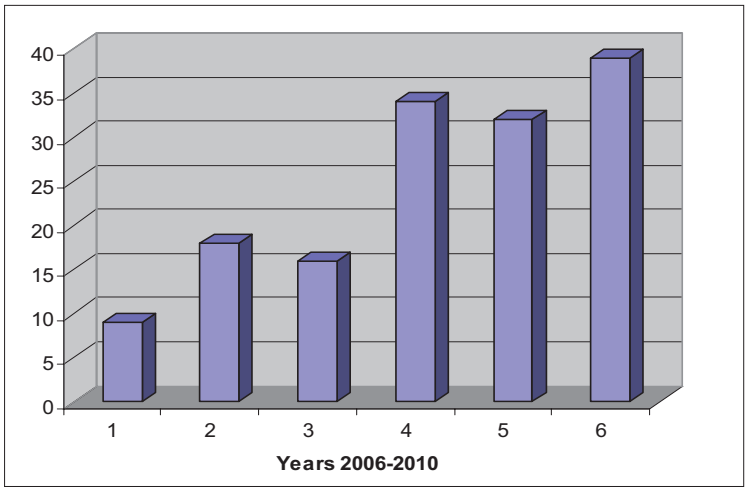


Figure 30. Associated Interventions on the Tricuspid Valve

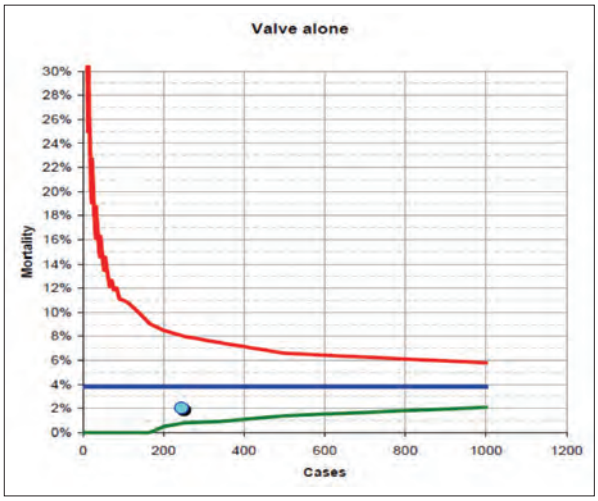


Figure 31. Funnel Plot for Isolated AVR Mortality

Number of cases	**244**	*<----enter value here*
Number of deaths	**6**	*<----enter value here*
Observed mortality	**2.46%**	
Performance	**slightly low - probably normal**	
Expected mortality *(=average Euroscore for these cases)*	**5.59%**	*<----enter value here*
Upper control limits		
2 s.d.	**8.61%**	
3 s.d.	**10.25%**	
3.5 s.d.	**11.48%**	
4 s.d.	**12.30%**	
Lower control limits		
2 s.d.	**2.87%**	
3 s.d.	**1.64%**	
3.5 s.d.	**1.23%**	
4 s.d.	**0.82%**	

Figure 32. Control-Limit Calculator:AVR

disadvantages of using funnel plots for data monitoring and confirms continued satisfactory performance with this group of patients. Using control limits in Figure 32 we can see our performance against the predicted risk is better than expected but probably within normal limits.

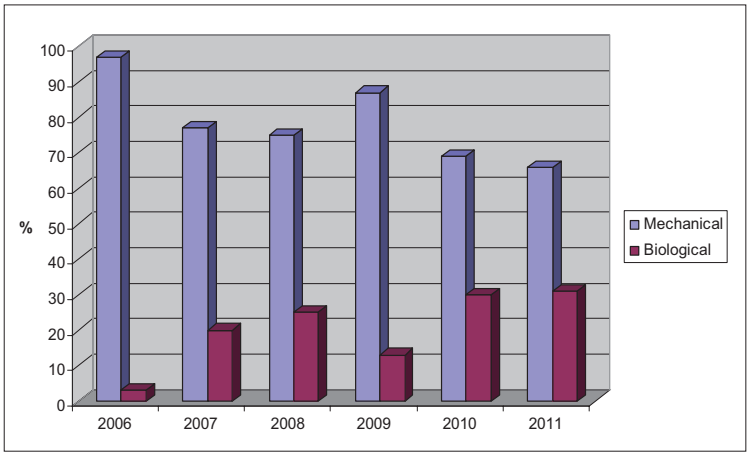


Figure 33. Aortic Valve Replacement: Choice of Prosthesis

As our patient population undergoing valve replacement is comparatively young, we continue to use a predominance of mechanical valve prosthesis but with a gradually aging population, particularly those presenting for replacement of the aortic valve due to age related aortic stenosis we have seen an increasing number of biological valves being implanted over time (Figure 33). This is a common international trend and is also consistent with reports of improved durability of certain types of biological valve resulting in their use in younger patients.

Patients With Multiple Valve Disease.

Patients undergoing double or triple valve surgery represent a

challenging group of patients with reported mortalities of 6.9% for first time surgeries in some Registries ((UKCSR).

In our group, 55% were female and the mean age was 57 (range 20-81). Preoperative logistic EuroSCORE was mean 5.96. Fifteen patients (7.9%) had undergone previous cardiac surgery. 4.3% of patients had associated coronary artery disease and required addition of coronary bypass procedure. Ninety patients presented with Class III/IV NYHA symptoms (47.8%) and 22 (11.7%) had evidence of severe ongoing heart failure. Nineteen patients (10.1%) required urgent or emergency surgery. 2.7% had evidence of pre-operative renal impairment and 4.8% had associated obstructive airways disease. Five patients (2.7%) presented with previous permanent neurological deficit and 7 patients (3/7%) had previously had a neurological event with full recovery. 22.9% had evidence of only fair or poor left ventricular ejection fraction.

Mortality was 4.8% (9 patients) for the overall group and for elective operations mortality was 3.6% (6 patients). Reoperation for bleeding was 5.3% overall and 4 patients (2.1%) developed a new post-operative stroke. Three patients (1.6%) required new post-operative dialysis on a temporary basis.

We believe this demonstrates excellent outcomes in a complex group of patients.

9. Aortic Surgery

As mentioned previously this has continued to expand not just in terms of number but also in terms of complexity of cases undertaken. As our Unit 'matures' it is recognised that with a high incidence of operative intervention for aortic dissection a growing cohort will re-present with complex problems inherent on their original disease and will require complex treatments for which we liaise with colleagues in vascular surgery and radiology. It is intuitive that complex patients like these will have a profound impact on our service as the numbers increase.

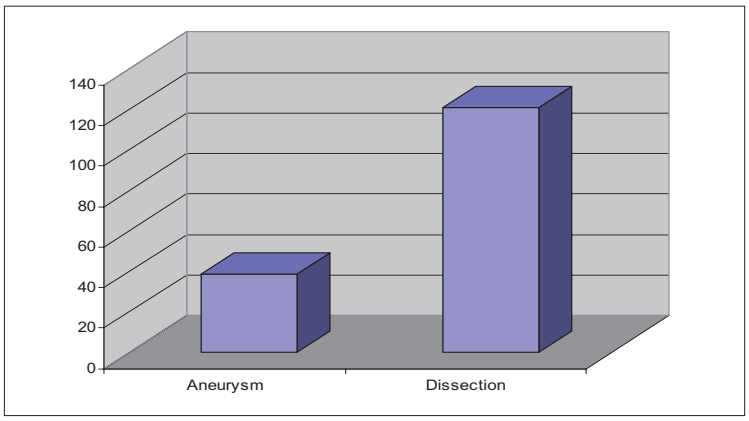
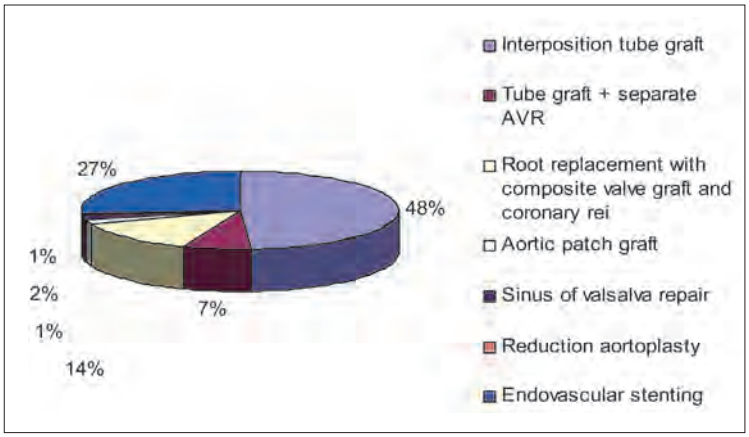


Figure 34. Site of Aortic Intervention

With a preponderance of cases involving acute type A dissection (Figure 34) the commonest procedure was interposition tube graft replacement of the ascending aorta with valve-leaflet preservation (Figure 35). This distribution is very similar to UK data.

Figure 36 shows the distribution of procedures performed according to anatomical segment of the aorta. For interventions on the aortic arch, we classify arch replacement as either conventional surgery with re-implantation of 2 or more head and neck vessels or endovascular stenting requiring de-branching procedure to provide a landing zone for the stent. Of the 97 patients undergoing urgent, emergency or salvage interventions for acute aortic dissection the mortality was 9.2% (9 patients)

Figure 35. Ascending Aortic Pathology



Stroke is a particular risk in this group of patients and in our cohort we had 6 permanent strokes (3.8%).

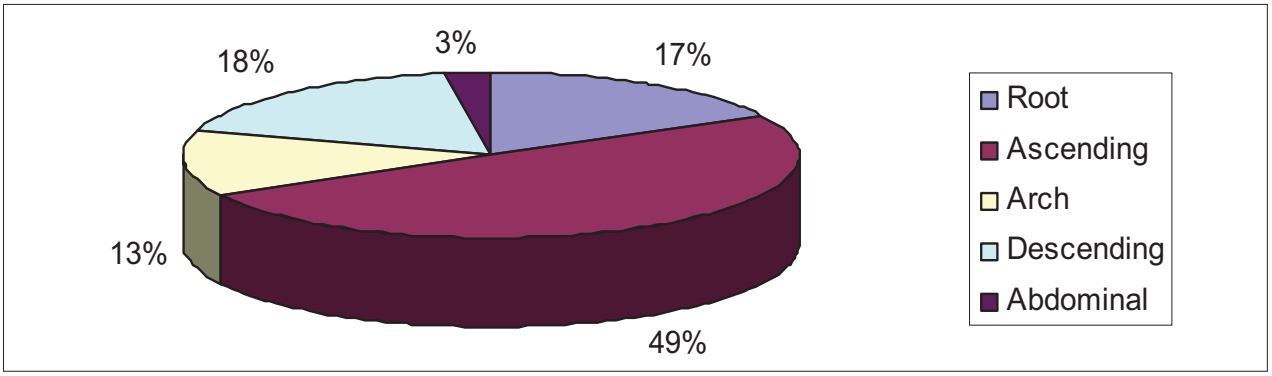


Figure 36. Aortic Procedures

10. Coronary Artery Bypass Grafting

Coronary artery bypass grafting has been chosen by the UK Society as the 'marker' operation for outcomes since it has been analyzed in-depth, it is commonly performed and the outcomes are reproducible and well delineated. We have again looked at this sub-group of patients in detail.

Patient Demographics

We now have 987 patients who have undergone isolated coronary surgery on our database. Patient demographics remain essentially unchanged, eighty percent (79%) of patients were male which is comparable to UK series where women have consistently represented around 20% of the cohort group undergoing coronary artery bypass grafting (UKCSR). 27% of our patient population are over 70 years of age, with the proviso mentioned previously about the unique position in Hong Kong in determining exact chronological age. This has been a consistent finding mirrored in the last report and sustained over the six year period of data collection.

In terms of pre-operative symptoms, 37% of our patients have class III/IV angina, which is lower than the UK. Overall, 24.2% of our cohort underwent urgent or emergency operation (cf 13% in last report).

However trends over time show how much this patient population is changing and there has been a sustained reduction in elective cases and as Figure 37 shows during the last 2 years over 40% of our case load is undertaken as urgent or emergency cases compared to just 13% in 2006 and 2007. This has a major impact on service provision.

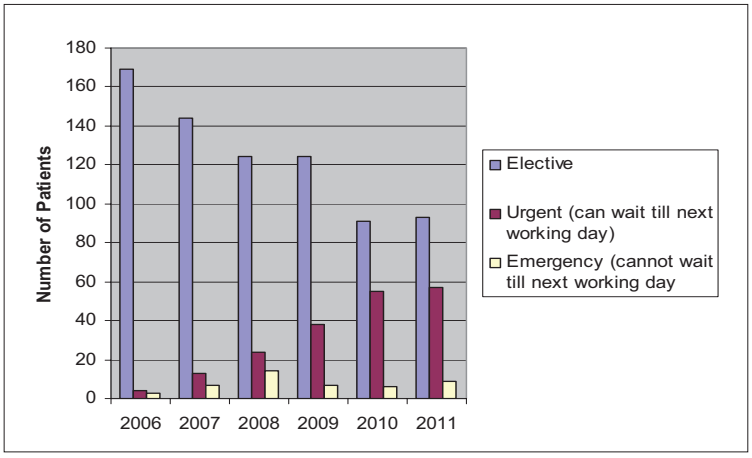


Figure 37. Change In Urgency of Operation in CABG Patients

It has not just been the timing of surgery which has changed in our coronary population.

Stroke is a cause of major post-operative morbidity following CABG and the risk is increased in patients with a history of neurological disease. In terms of pre-operative neurological problems, 9.5% of our patients had had a previous neurological event either a transient event (2.7%) or a full stroke with either a full recovery (4.8%) or a residual neurological deficit (2.0%).

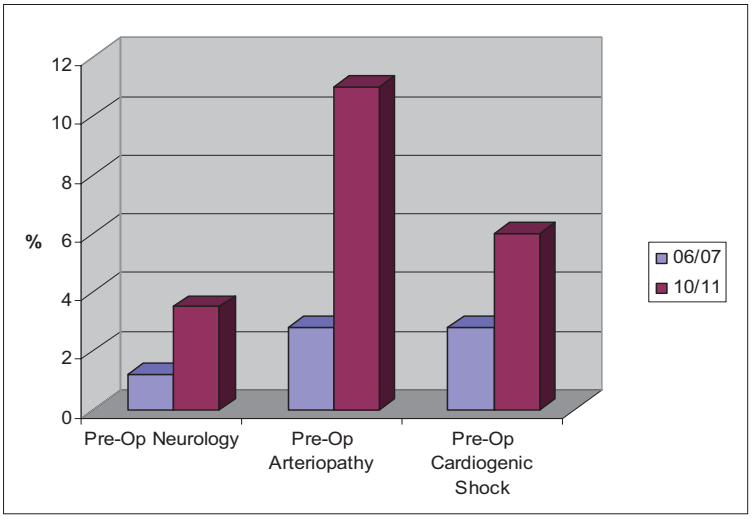


Figure 38. Change in Pre-operative Variables

As Figure 38 shows pre-operative risk factors such as history of peripheral vascular disease or previous stroke have increased dramatically.

55% of the patients operated on overall had suffered a previous myocardial infarction. This is higher than in the UK (just over 40%). Over nine percent of our patients had suffered 2 or more myocardial infarctions. In general terms, the sooner after a myocardial infarction patients undergo coronary artery bypass grafting, the higher the potential risk. Figure 39 shows the change in the timing of surgical intervention we have seen over the past 6 years. There are still very few patients who require surgery within 6-24 hours of myocardial infarction, but we have seen a dramatic increase in the number of patients operated upon within 1-30 days. This fits with our previous observations that as a whole, our population requiring coronary revascularisation seems to be presenting with more severe symptoms

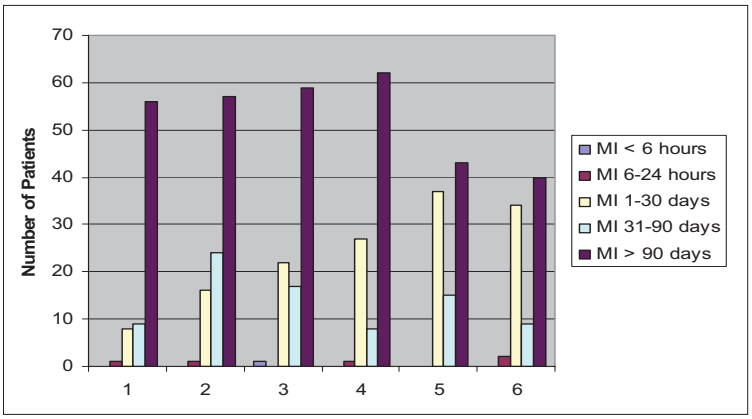


Figure 39. Timing of Surgery in Relation to Previous Myocardial Infarction

and hence require earlier surgery despite a theoretical increase in risk which we have noted in previous reports. This trend has continued.

Overall, 17% of our patients had undergone prior percutaneous coronary intervention.

70% had hypertension (defined using the EuroSCORE classification) (UKCSR 62%) with a perceived slight increase (Figure 40) and the number and type of patients with diabetes is shown in Figure 41. This incidence has remained relatively stable over the last 6 years and remains high in comparative terms as nearly 50% of patients have some form of diabetes (UKCSR 23%) 43% on oral or insulin therapy.

The incidence of this pre-operative morbidity has remained constant over the six years (Figure 42).

As mentioned, many patients with severe coronary disease are prescribed protective drugs such as aspirin and clopidigrel which however beneficial can cause problems with post-operative bleeding by interfering with the coagulation cascade in patients undergoing surgery. Ideally, these medications should be stopped

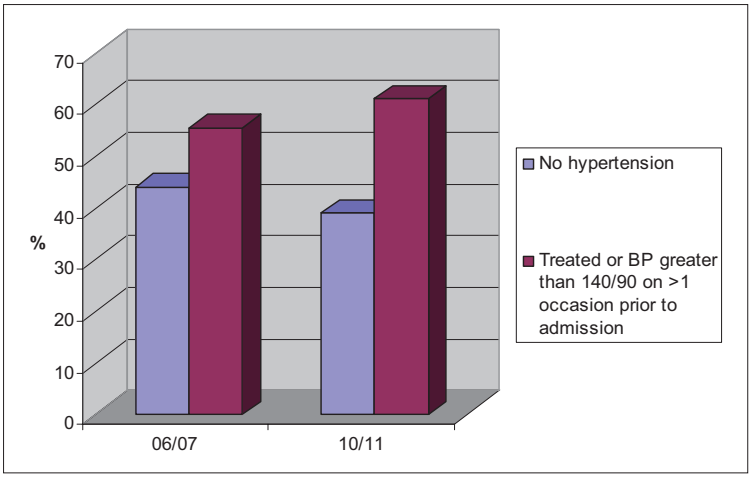


Figure 40. Incidence of Hypertension

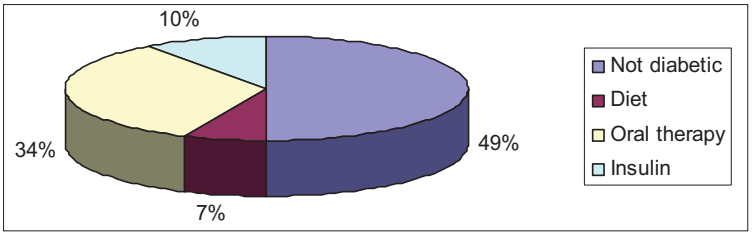


Figure 41. Types of Diabetes

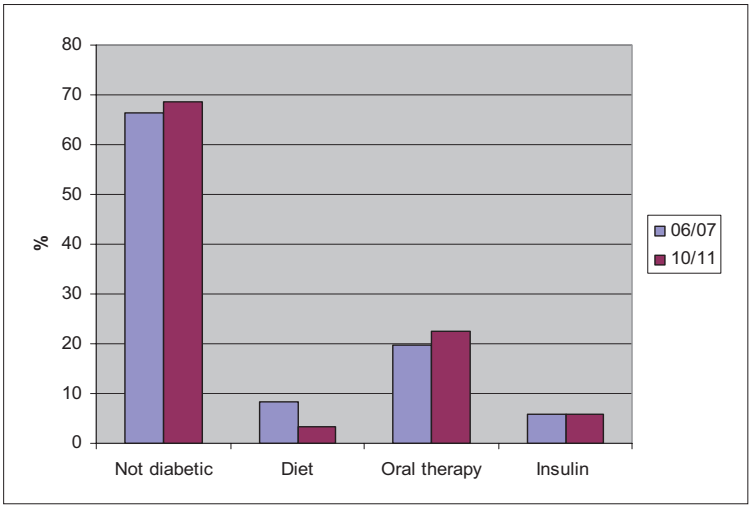


Figure 42. Incidence of Diabetes

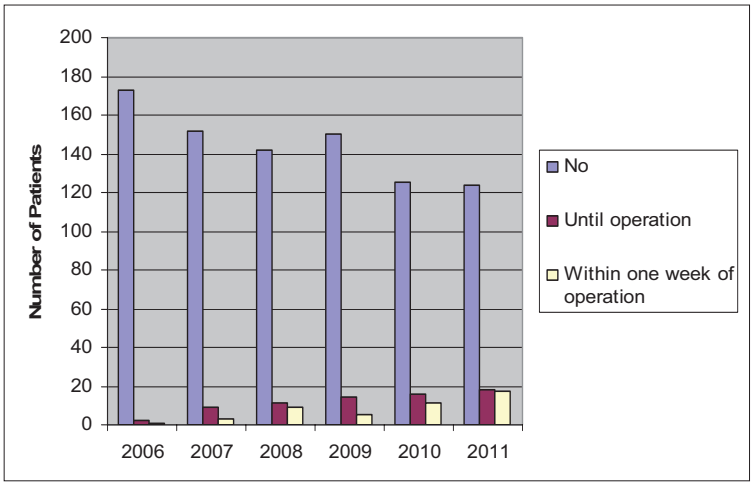


Figure 43. Patients on Intravenous Nitrates Prior to Surgery

prior to surgery but the trend we have shown is a reflection of the increasing severity of coronary disease in the patients we are treating and in whom it is thought to be 'unsafe' to discontinue this medication despite the additional risks posed during revascularization. This is also demonstrated by the increasing numbers of patients who undergo surgery whilst being treated with intravenous nitrates or heparin either within one week of such treatment or even whilst such treatments are continuing which we have noted in previous reports and this trend continues (Figure 43). The most dramatic change over time occurs in the patient population who are still taking aspirin prior to surgery, a trend which is an almost complete reverse of the situation in 2006 (Figure 44).

Coronary Disease and Heart Function

Just over 75% of our cohort had triple vessel coronary disease, a constant finding over the six years. Similarly, the incidence of left main

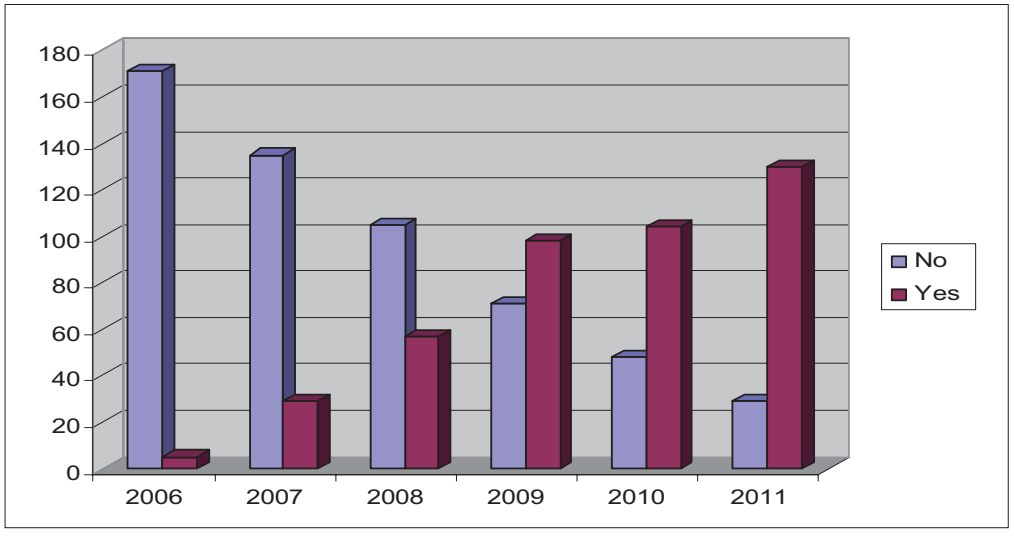


Figure 44. Patients on Aspirin Prior To Surgery

stem (LMS) stenosis has remained constant (40.1%) but remains much higher than in UK series (21%).

Heart function (ejection fraction) remains one of the most important predictors of post-operative outcome. Overall, 28% of our patients undergoing CABG had moderate or poor left ventricular function.

Conduits for CABG

Over 95% of our patients receive one or more arterial graft, usually the left internal mammary artery (LIMA) to the left anterior descending artery. This is an important factor in long term outcome and compares well with the UK national figure (UKCSR 94%) and has remained constantly high over the six four year period as previously noted. A constant 74% of our patient are revascularised with 3 or more bypass grafts.

Summary

We have demographic data regarding the patient population we are referred for surgical revascularization and the complex changes which we have noted previously have continued during the two year, in some areas in dramatic fashion. The incidence of co-morbidities like diabetes and hypertension have remained relatively static as has the incidence of left main stem stenosis, but all are still much higher than in other international series. This has been a consistent finding over six years now.

Patients we are now referred have more severe symptoms, are more likely to have had previous myocardial infarction, and within this cohort the number of patients suffering with 2 or more infarctions has increased. Due to severe symptoms we have to operate on patients sooner after their myocardial infarction and whilst they are being treated with clopidigrel or aspirin (a dramatic increase) and also whilst receiving nitrates or heparin. All of these factors will result in an increase in the risk profile of this patient population and each index has steadily increased in proportion over time. This has been reflected in

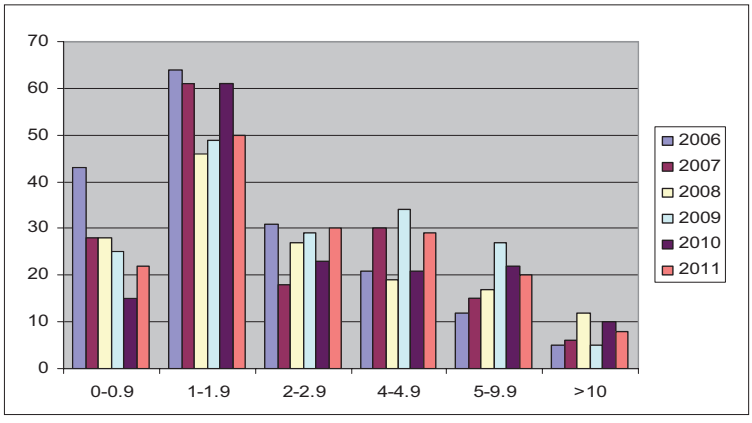


Figure 45. Changing Risk Profiles Assessed By Complex Bayes Score Over Time

changes in the risk scores using the complex (9-factor) Bayes Score (Figure 45) (see below). Over time, there have been reductions in the number of patients in the 'low' score (<1 – 2.9) and increases in the proportion of patients scoring more highly, particularly scores of 5-10.

11. CABG Outcomes: Mortality and Bleeding

Our overall crude-mortality for coronary artery bypass grafting was 1.3 %. There has been no significant change over time despite the increasing risk profile. A trend towards increasing risk but reduced mortality has been recognised internationally in this cohort of patients (2). From our cohort whilst the incidence of elective surgery is declining dramatically, over the 6 years 745 patients have undergone elective revascularisation with 5 deaths a crude mortality of 0.7%.

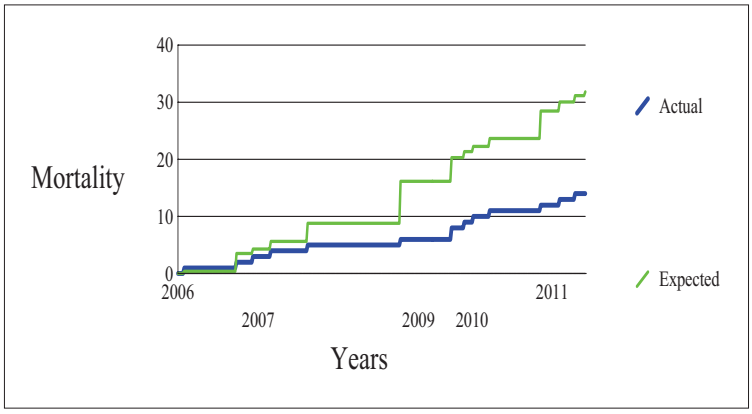


Figure 46. CABG Mortality RA-CUSUM Chart (versus complex Bayes Score)

In the UK, a complex Bayes score has been demonstrated to be a valid and accurate risk-profiling score for the sub-group of patients undergoing coronary artery bypass grafting (Appendix 2) and we have previously validated the applicability of this scoring system for our CABG population.

Figure 46 shows outcomes in our CABG population for the period of data collection in the format previously described CUSUM format. This time the complex Bayes score was used as the risk scoring system and performance again is shown to be entirely acceptable.

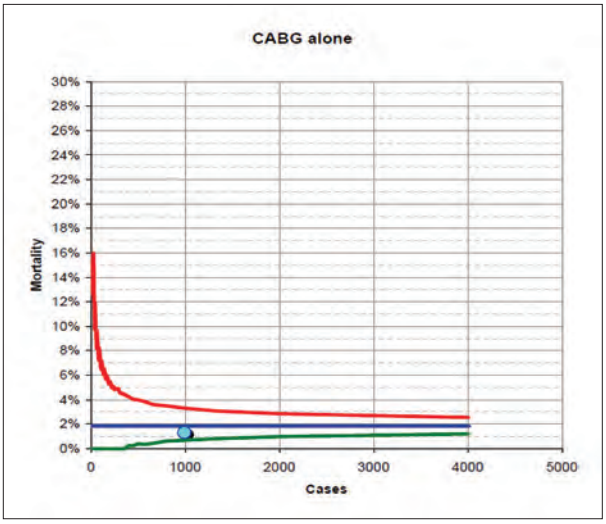


Figure 47. Funnel Plot of CABG Mortality

Number of cases	**990**	<----enter value here
Number of deaths	**13**	<----enter value here
Observed mortality	**1.31%**	
Performance	**definitely better than expected**	
Expected mortality *(=average Euroscore for these cases)*	**3.50%**	<----enter value here
Upper control limits		
2 s.d.	**4.75%**	
3 s.d.	**5.35%**	
3.5 s.d.	**5.76%**	
4 s.d.	**6.06%**	
Lower control limits		
2 s.d.	**2.42%**	
3 s.d.	**1.92%**	
3.5 s.d.	**1.62%**	
4 s.d.	**1.41%**	

Figure 48: Control-Limit Calculator:CABG

As previously we have also looked at our outcomes using a risk-adjusted funnel plot. This is shown in Figure 47 along with the control limit calculator in Figure 48 which does indeed performance is genuinely better than risk predicted.

In view of the changing risk profile of our CABG population and the increasing number of patients on drugs which may increase the risk of post-operative bleeding we looked at our blood transfusion and re-operation rates in this sub-group of patients as we did previously but now with a six year period of comparison. Figure 49 shows the CUSUM plot for re-operation using a reported 3% 'fixed' comparator from international (UK) data and despite the increased potential risk we are still performing well with a crude re-operation rate of 1.5%.

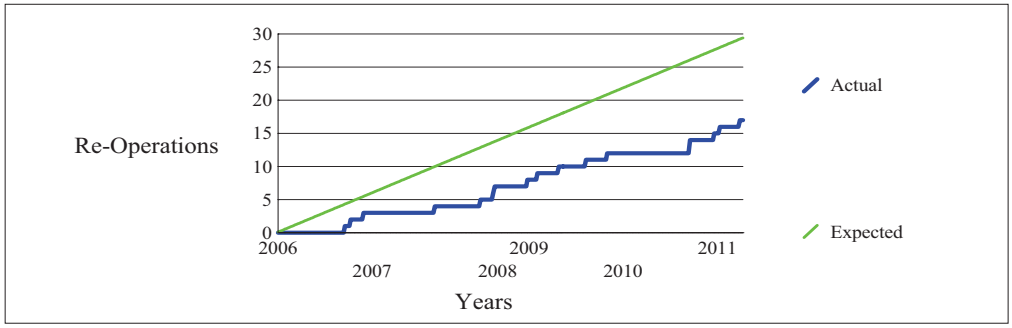


Figure 49.Re-operation for Bleeding after CABG

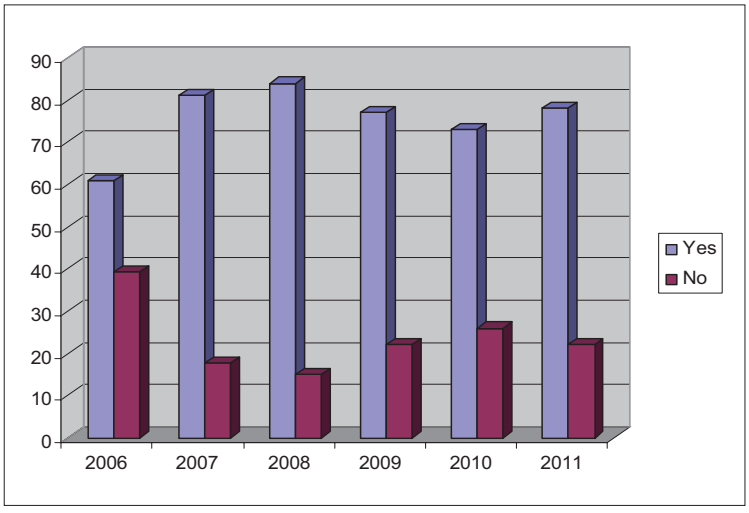


Figure 50. Freedom From Transfusion of Blood on ICU

In terms of blood loss, we have noticed similar trends reported for our overall activity in that we have noted an increase in the number of patients in the 'higher' blood loss group. Despite this a constant 75-80% of our patients do not receive a blood transfusion (Figure 50). Transfusion of blood products again mirrored whole blood usage.

Stroke is a risk following coronary surgery and one of the most serious and depressing complications in this group of patients. In our cohort, 6 patients suffered a permanent stroke an incidence of 0.6% which is in line with international data.

12. Emergency and Salvage Cases

We have followed the story of monitoring outcomes following cardiac surgery from the United Kingdom with interest. In recent times, emergency and salvage cases have stopped being incorporated into the portfolio of cases which are used for assessing performance. This to us seems a reasonable move since they represent a diverse and heterogeneous group and most often are undertaken when there is no other option than death for the patient. As such they are a complex group to risk stratify and risk scoring systems are notoriously inaccurate in this group. However, we believe that they should be scrutinised in some way and we do monitor them as a separate entity. By the EuroSCORE definition an emergency procedure is one which is undertaken before the next working day (198 patients) and salvage procedures are cases which require immediate transfer to the operating room (13 patients).

Figure 51 shows the distribution of these cases from 2006-2011, a total cohort of 211 patients. In our Institute, emergency or salvage intervention is most often undertaken for aortic emergencies. This patient group had a mean age of 61 not too different to our patients as a whole and a mean logistic EuroSCORE of 26 although as stated this is notoriously inaccurate as a figure to predict risk in this group. In the coronary population 15% had pre-operative IABP inserted. 12% of these patients were ventilated pre-operatively and 30% designated as being in cardiogenic shock. Just under 6% were re-operations. In the group who required aortic or valvular intervention the sites of intervention are shown in Figure 52 which emphasis the heterogeneous and complex nature of this group of patients and Figure 53 shows what appears to be a year on year increase in cases from 2008 onwards.

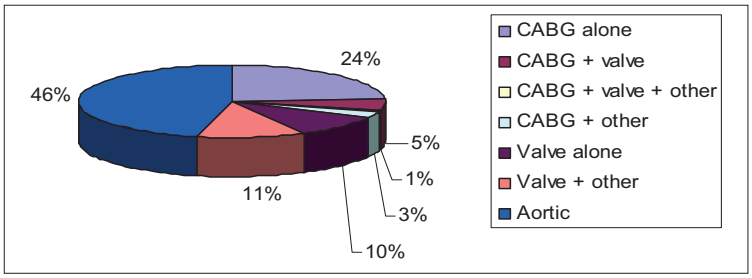


Figure 51. Emergency and Salvage Cases

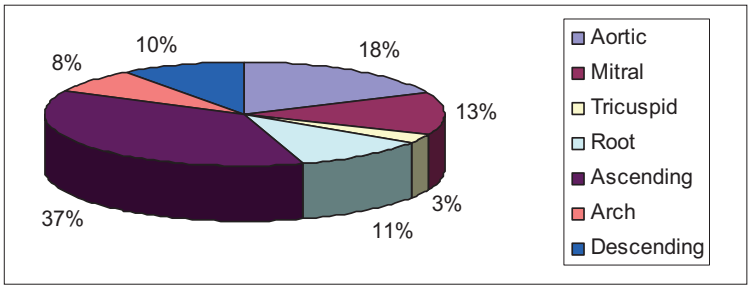


Figure 52. Sites of Intervention For Aortic and Valvular Emergencies

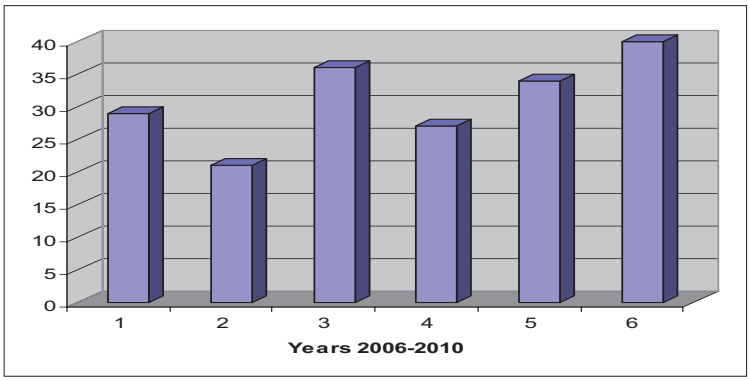


Figure 53. Emergency and Salvage Cases

In terms of outcomes mortality was 11.8% (25 patients), incidence of permanent stroke 3.8%, and need for new haemodialysis 8.1% all obviously much higher than for our elective and urgent cases. Despite this, these crude outcomes are well within reported international outcomes for this complex group of patients in whom quite often surgery is the only chance of survival. Put another way, the survival of patients following emergency and salvage surgery in our Institute approaches 90%. We will however continue to specifically monitor outcomes in this group.

13. Data Quality and Validation

We continue to collect our data and adhere to the principles of the most accurate collection being at the point of clinical care, sharing responsibility for data collection amongst professionals responsible for patient well-being and using an independent party for direct data entry and data checking on completion of the patient journey. This is proving difficult in times of manpower shortages and the reality is we are becoming increasing reliant on data collection by our Research Fellow an issue we aim to address in the coming year.

We continue with our validation process whereby every outcome reported as a death is double-checked for all data entry fields and cross-checked with patient and perfusion records along with computerised patient clinical records and data requested by our mortality and morbidity Departmental process. We have previously described the 'external' validation of data completeness in the form of publications from the UKSCTS following the benchmarking exercise and more recently with the EACTS documented previously.

Prior to collating data for this report we assessed data completion in 9 fields chosen because of their importance as outcomes or as variables contributory to calculating risk scores. These were: Age, Ejection Fraction Category, Operative Urgency, Pre-Operative Ventilation, IABP Use Pre-Operative, Stroke, Post-Operative Dialysis, Re-Operation and Death.

Data was 100% complete for Age, there was 1 unknown for all other categories and an additional 4 missing data entries in the Ejection Fraction category. Traced back the one unknown was actually a test patient whose entry was deleted. For EF missing data, actually values had been entered but category unchecked. We can be sure that the database is fit for purpose in terms of data completeness and data validation is done on data entry.

14. Quality of Care for Cardiac Surgical Patients

Overall provision of quality care for cardiac surgical patients extends beyond mortality and to look at some aspects of care we have focused on the population of patients undergoing coronary surgery. We have described our 'quality bundles' previously. One focus has been the percentage prescription of aspirin or statins to patients following coronary artery surgery upon their discharge. We now have 100% data on these variables and overall 92.6% of our CABG patients are prescribed aspirin on discharge and for the remaining 7.4% an alternative is used or contra-indication documented (Figure 54). Figure 55 shows the same information for statins prescription and for the last 2 years we have achieved a discharge prescription rate of approaching 95%.

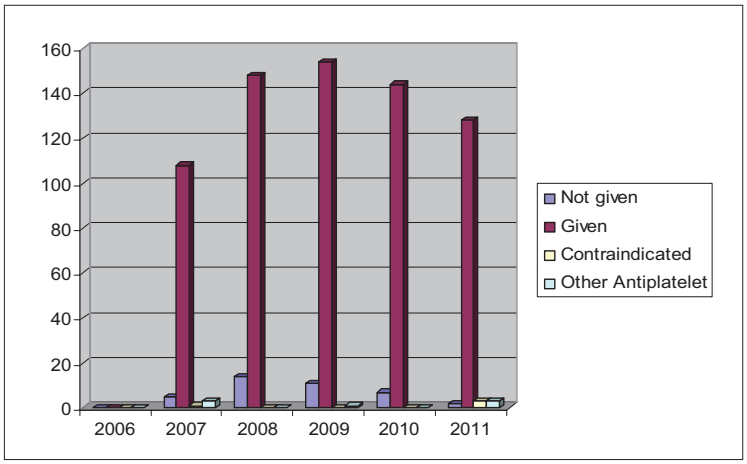


Figure 54. CABG Patients: Discharge Aspirin Prescription Over Time

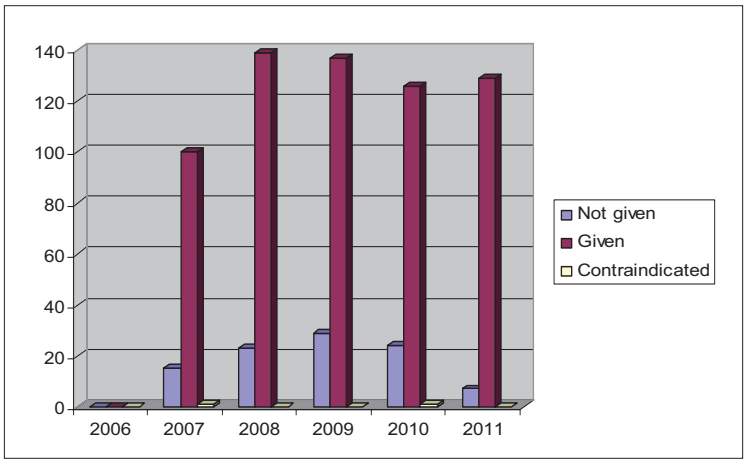


Figure 55. CABG Patients: Discharge Statin Prescription Over Time

We measure length of stay (as well as incidence of prolonged stay) as a quality indicator; our median length of stay for all patients is 7 days. However, as we have stated previously, we must always look at this in the context of discharge facility within our local area.

Length of hospital stay following surgery is purported as a 'quality' measure but can be impacted by local facilities for rehabilitation and other amenities. Benchmarking is an important component of quality assurance programmes and The European Society for Cardiothoracic Surgery (ESCTS) Database includes data from over 29 countries in Europe, 50 hospitals from mainland China and outcomes for over 1 million cardiac procedures. We have used this previously for benchmarking (1).

Data from 1899 CUHK/PWH patients showed 1839 patients survived to discharge (96.8%). Of these, 1482 patients (78%) were discharged directly to home. 1.5% (29 patients) were admitted to convalescence facility and 306 (16.1%) were discharged to another hospital (referring centre). 21 patients discharged home from PWH (1.1%) had been transferred to another specialty within PWH prior. ESCTS benchmarking showed CUHK/PWH post-operative stay following CABG (n=502) was mean 6.7 days, whole database, n=208156, 10.0 days and Asian Zone, n=8768, 12.6 days (Figure 56 below).

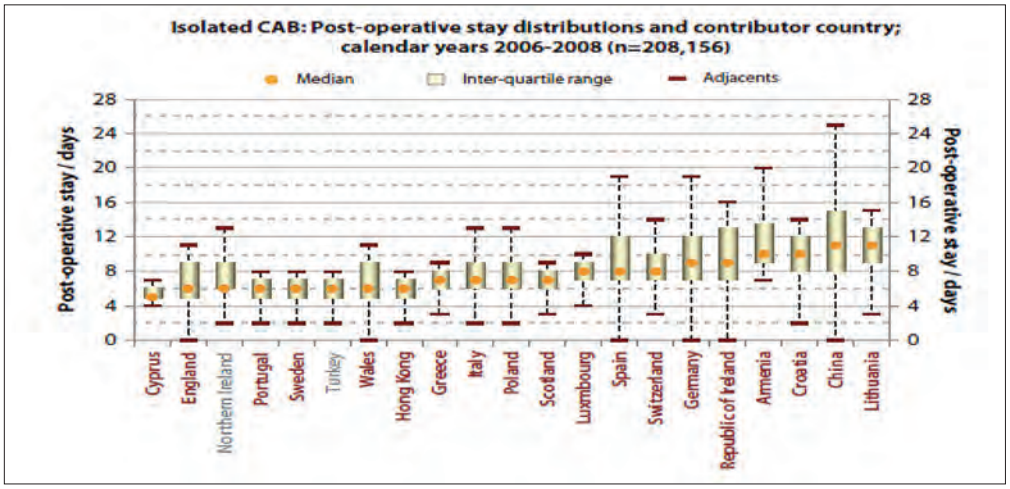


Figure 56.

The majority of patients following cardiac surgery at CUHK/PWH are discharged directly home as local rehabilitation facilities are limited. Despite this, international benchmarking has shown the post-operative stay following CABG is comparable if not shorter than Western and other Asian Countries

15. Real-Time Monitoring of Outcomes

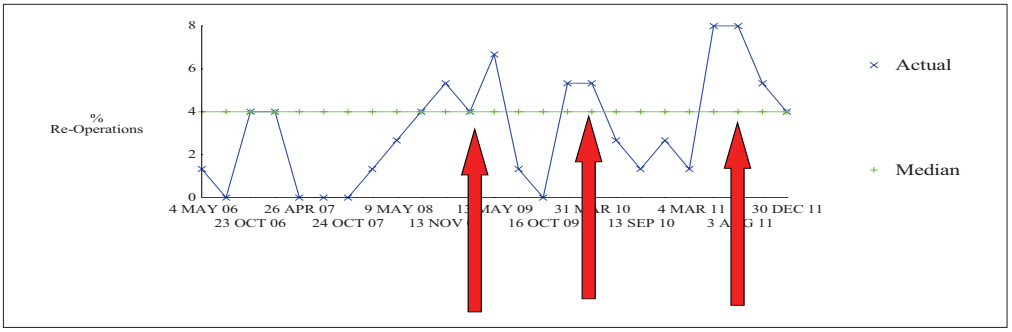


Figure 57. Runs Analysis of Re-Operation For Bleeding With 'Trigger' Points For Intervention

In establishing our data collection process and developing the 'audit trail' we have been setting the infra-structure to allow us to monitor in 'real time' a variety of outcomes, documenting trends which would allow divergent performance to be detected early and allow appropriate intervention to take place to maintain optimum outcomes for our patients. We have continued monitoring at 3 monthly intervals: mortality, re-operation for bleeding, blood transfusion on ICU and use of LIMA in CABG. We have a set of criteria which define 'divergence' for each and a set of responses such divergence would trigger. For example, in any 3 months sampling period, if our transfusion rate in ICU increases over the plotted median (70% transfusion free) by 10%, or if there is a 5% increase in two consecutive periods we will instigate a formal audit for a 3 month period and perform risk assessment of case-mix. These monitoring curves are automatically generated using our database analysis module. Figure 57 shows a runs analysis plot for re-operation for bleeding for the time 2006-2010. There have been the individual trigger points indicated where the incidence of re-operation exceeded our alert line and these were investigated according to case mix, operating surgeon and type of surgery. No common factors were found and we can see performance returns to within 'expected' limits which are the usual experience with these variations. However, the exercise would hopefully identify any compounding and remediable factors if they were present and we continue to monitor the area we outlined above with this technology.

Summary

1. Using six years cumulative data we have shown that we are performing in line with international standards for all cardiac surgical activity and all operative sub-groups and exceeding expected survival in some categories.

2. Outcomes other than mortality are excellent and well within international standards.

3. We have confirmed previous observations that there are inherent differences between our patient population and that of the UK and Europe but despite this, very similar risk profiles.

4. We have shown that in terms of overall activity we perform fewer coronary artery bypass grafting operations and more valve operations than comparative units in the United Kingdom and Europe.

5. We have seen a continued change in overall surgical practice with an increasing risk profile of our patients when assessed using the logistic EuroSCORE for all patients and the Bayes Score for coronary patients. This has occurred year on year for 6 consecutive years.

6. We have recorded excellent outcomes for mitral and aortic valve operations

7. We have documented increased activity in surgery for the aorta both conventional and endovascular with again outcomes comparable with the highest international standard.

8. We have again seen significant changes in the demographics of our CABG population who are now most likely to require urgent surgery for unstable angina or complex coronary disease.

9. The demographic changes in the CABG population have resulted in surgery continually being required earlier after previous myocardial infarction and in many instances whilst the patient is still on intravenous treatment with heparin and nitrates and operating on patients who are still taking aspirin is becoming routine.

10. Despite demographic changes resulting in increasing risk, we have shown risk-adjusted outcomes for the subset of patients undergoing CABG is excellent and has been sustained over the six year period.

11. We use 'real time' monitoring of selected outcomes with mechanisms to address divergent practice.

References

1. www.eacts.org: (last accessed January 2013)

2. Underwood Malcolm John; Hu Shengshou; Lee C N; Kappatein A P and Bridgewater B. "International Benchmarking of Cardiac Surgical Activity and Outcomes". Asian Cardiovasc Thorac Ann 2012 20 (1) 9-11.

3. http://www.surgery.cuhk.edu.hk/surgical-audit/: (last accessed January 2013)

4. http://www.scts.org/modules/resources/default.aspx?type=bluebook: (last accessed January 2013)

Acknowledgements

Multidisciplinary team work is required to provide a comprehensive cardiac surgical service. Much attention is naturally given to the surgical arm of this effort but as we noted in previous reports and must continue to affirm:

'The activity and outcomes presented here demonstrate par excellence the benefits of teamwork. None would have been possible without a wide range of associated personnel, including cardiology, anaesthetic and intensive care colleagues, junior medical colleagues, ward, intensive care and theatre nurses, perfusionists, physiotherapists, pharmacists, blood bank technicians, laboratory technicians and many other support personnel. Outcomes and service provision in this and future reports reflect the dedicated effort of all these professionals'.

All of their efforts are crucial in maintaining our excellent outcomes particularly in the face of changing and increasing patient risk profiles. We continue to face many pressures as we seek to deliver even higher quality care for our patients; all of the above mentioned professional groups have worked and continue to work above and beyond expectations to ensure that our standards are consistently maintained. This is particularly pertinent when we are stretching the limits of current resource.

We continue to acknowledge all of the doctors, nurses, perfusionists and associated personnel who have contributed to data collection and enable us to do so prospectively and at the point of clinical care. We believe all personnel involved in care also have a duty to collect data and ensure quality and this has been taken on with vigour by the majority. The research personnel we are employing on the database project have contributed more than just validation and data entry and are now an integral part of a well established team but we must be vigilant that we do not loose sight of the principles regarding data collection on which we based our practice.

Acknowledgements

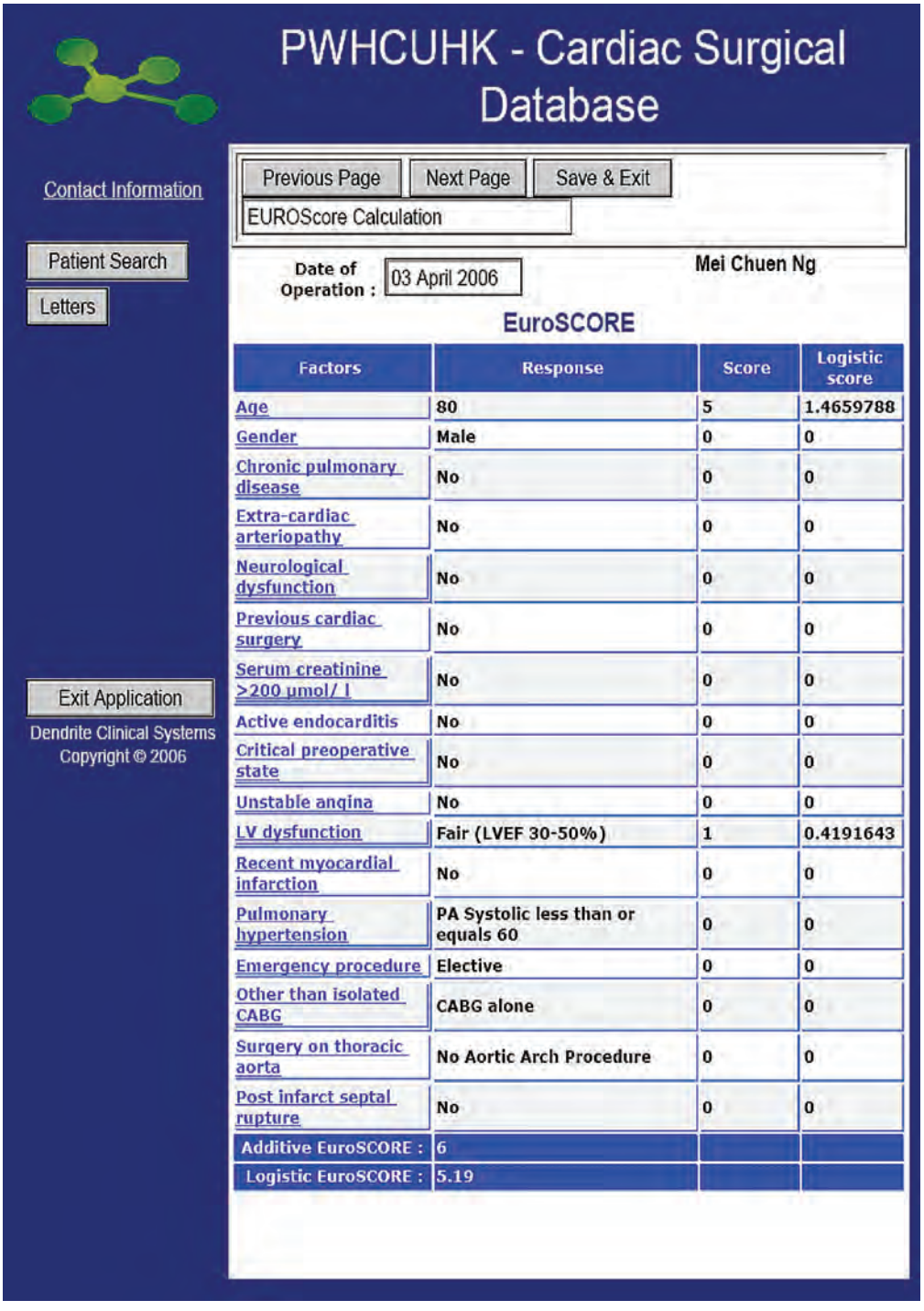
Our anaesthetists and intensivists have embraced our efforts and actively contribute to the thought processes involved in monitoring outcomes and implementing changes in practice. Our nursing staffs have been active as well and have sustained their first project, nurse-led defibrillation whilst embarking on a nurse-led follow-up clinical service for post-operative cardiac patients which we hope to bring to fruition later this year..

We thank surgical colleagues represented by the Cardiothoracic Specialty Group in Hong Kong for their support and we look forward to collaborative efforts as we extend this process to a national level. This year we have embarked on a process to integrate CABG outcomes on a National Level and at the time of writing database validation projects are being undertaken. None of this would have been possible without support from Dr Fung Hong, Chief Executive, New Territories East Cluster, and the Department of Quality and Safety at the HA, We continue to be grateful to Dr NT Cheung and all the HA IT team who continue to make a contribution.

We continue to thank Professor Sir Bruce Keogh, Medical Director of the National Health Service in the UK and Mr B Bridgewater, Consultant Cardiac Surgeon, Clinical Director of Cardiac Surgery, Trust Director of Clinical Audit, Wythenshawe Hospital Manchester UK and Chairman of the UK Cardiac Surgery Database Committee for embracing and supporting our international benchmarking initiative and who often give informal but invaluable advice.

We remain humbled at being allowed such access to the world's foremost cardiac surgical database. We would again like to thank Dendrite Clinical Systems for their continued support.

Appendix 1



PWHCUHK - Cardiac Surgical Database

Contact Information

Patient Search

Letters

Exit Application

Dendrite Clinical Systems
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EUROScore Calculation

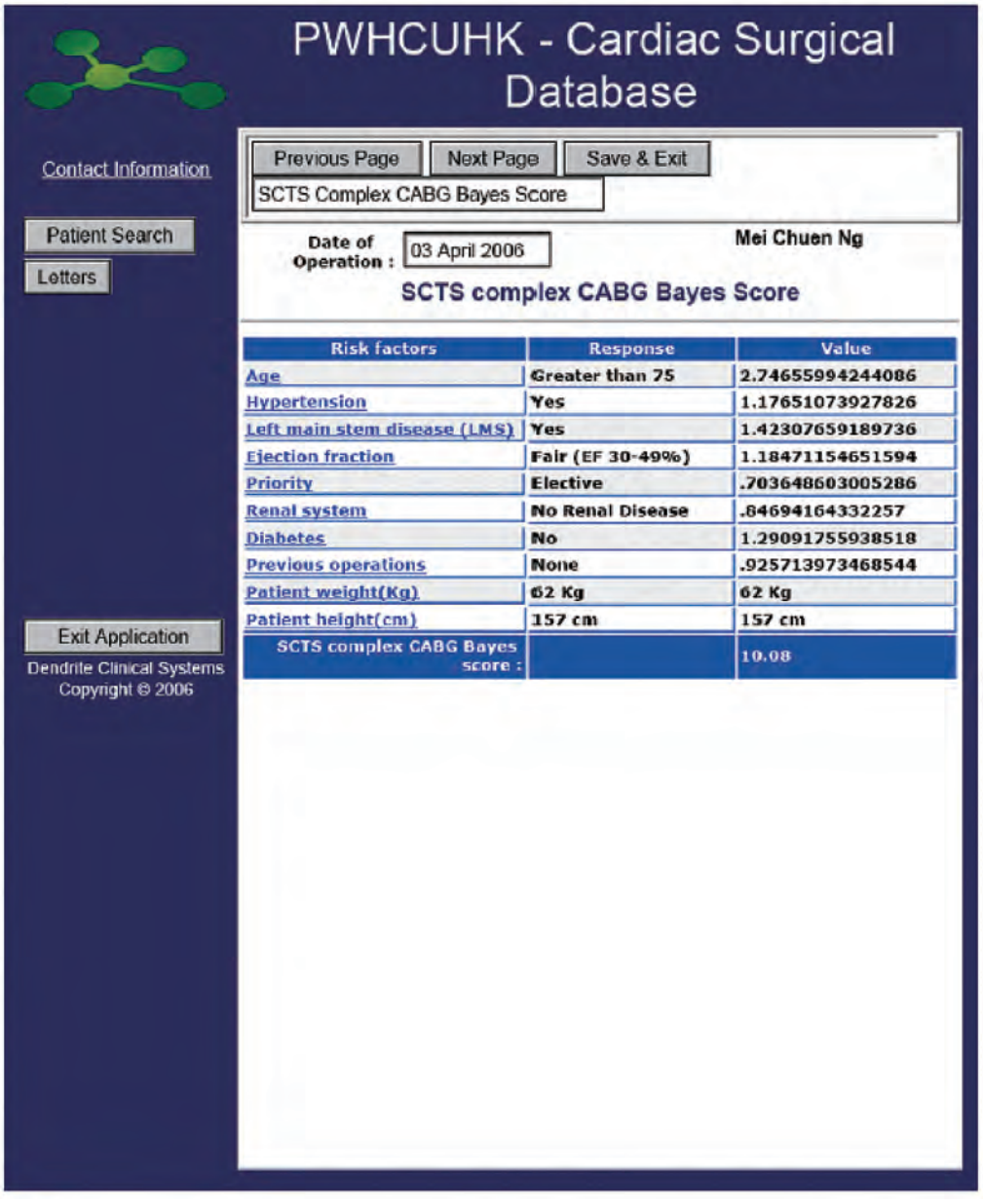
Date of Operation : 03 April 2006

Mei Chuen Ng

EuroSCORE

Factors	Response	Score	Logistic score
Age	80	5	1.4659788
Gender	Male	0	0
Chronic pulmonary disease	No	0	0
Extra-cardiac arteriopathy	No	0	0
Neurological dysfunction	No	0	0
Previous cardiac surgery	No	0	0
Serum creatinine >200 µmol/ l	No	0	0
Active endocarditis	No	0	0
Critical preoperative state	No	0	0
Unstable angina	No	0	0
LV dysfunction	Fair (LVEF 30-50%)	1	0.4191643
Recent myocardial infarction	No	0	0
Pulmonary hypertension	PA Systolic less than or equals 60	0	0
Emergency procedure	Elective	0	0
Other than isolated CABG	CABG alone	0	0
Surgery on thoracic aorta	No Aortic Arch Procedure	0	0
Post infarct septal rupture	No	0	0
Additive EuroSCORE :	6		
Logistic EuroSCORE :	5.19		

Appendix 2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Save & Exit
SCTS Complex CABG Bayes Score
Date of Operation :
03 April 2006
Mei Chuen Ng
SCTS complex CABG Bayes Score
Risk factors
Response
Value
Age
Greater than 75
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Hypertension
Yes
1.17651073927826
Left main stem disease (LMS)
Yes
1.42307659189736
Ejection fraction
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Priority
Elective
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Renal system
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Diabetes
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Previous operations
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62 Kg
Patient height(cm)
157 cm
157 cm
SCTS complex CABG Bayes score :
10.08