Are percutaneous coronary interventions changing our coronary surgery practice?

Alex Manchè, Aaron Casha

Abstract

Aim: The aim of this retrospective study was to assess the impact of a growing percutaneous coronary intervention (PCI) program on our coronary artery bypass graft (CABG) practice.

Method: The data were collected from 300 consecutive surgical patients from January 2000 (early series) and from a similar number from July 2008 (recent series).

Results: Our recent series presented an increased risk (mean Parsonnet scores rose from 5.5 to 7.3, mean euroSCORE rose from 2.4 to 3.1). The mean age increased from 60.3 to 63.8 years, with the percentage of patients over 70 rising from 14.3 to 29.1%. The proportion of females increased from 15.1 to 18.6%. Mean number of vessels grafted diminished from 3.24 to 3.02 per case. Fewer coronary arteries over 3mm diameter were grafted and more advanced atheroma was encountered at the site of grafting in the recent series.

Conclusion: The rise in PCI was associated with a smaller surgical population presenting an increased risk and challenge to the cardiac surgical team.

Keywords

Percutaneous coronary interventions, cardiac surgery

Alex Manchè* MPhil, FRCS(CTh)
Department of Cardiac Services
Mater Dei University Hospital, Malta
Email: manchea@maltanet.net

Aaron Casha MPhil FRCS(CTh)
Department of Cardiac Services
Mater Dei University Hospital, Malta

** corresponding author*

Introduction

Many surgeons bemoan the fact that patients get worse with every passing year.[1] Our prejudices are coloured by recent memories of a fatal surgical outcome and we tend to forget similar instances from the distant past. This study describes the evolution of surgical practice over an 8.5 year period with regard to population and vessel characteristics.

Figure 1a shows the incidence of PCI and CABG procedures in the US over the period 1980-2005.[2] It is fairly representative of what is happening the world over. Figure 1b shows a similar trend in Malta over the study period. Whereas surgery reached its zenith in the US in 1996, here it happened 8 years later. Our current operative intervention is down 40% from this peak in 2004. The merits of PCI versus surgery in terms of outcome have been the subject of extensive debate.[3,4] In some centres[5] this has lead to multidisciplinary management of patients in the selection process for the type of treatment modality offered, which included hybrid procedures. The surgeon is dealing with a smaller number of referrals as increasingly more of the traditional surgical patients are treated by cardiologists. The patients we now operate on are a subset of those we treated in 1995 when cardiologists were, by and large, tackling selective single vessel disease.

Methods

This retrospective single surgeon study analyses two groups of 300 consecutive surgical patients from January 2000 and July 2008 (8.5 year time lapse). Data were collected from operative records and from our database, which is compiled at the time of patient discharge from hospital. Vessel data pertained to the coronary artery at the point of grafting. Vessel size (determined with calibrated probes) and vessel quality were scored during surgery by the surgeon and his first assistant according to preset criteria.

The vessel was grafted at a suitable site distal to significant disease, as determined by prior angiography. Vessel characteristics (Table 1) pertain to this site. The vessel was classified as c1 if the calibre exceeded 3mm, as c2 if the diameter was 2-3mm, as c3 if the diameter was 1-2mm, and as c4 if the diameter was less than 1mm. A good quality vessel with normal thickness and no disease is denoted by q1, q2 denotes a vessel with significant atheroma at the site of anastomosis, q3 denotes a vessel of poor quality with calcified plaques at the site of

Figure 1a: *US trends for PCI and CABG, 1980-2005*

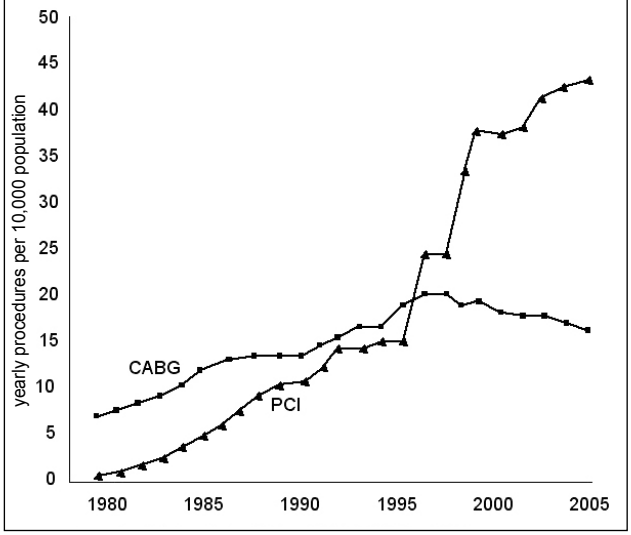
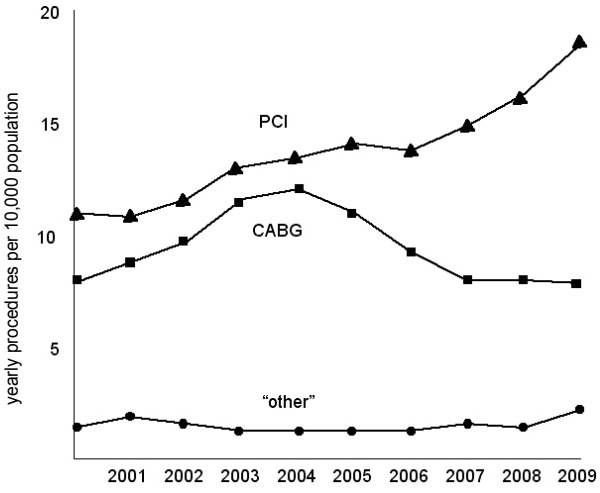


Figure 1b: *Trends in PCI and CABG over study period"other" denotes non-coronary surgery*



anastomosis, and q4 was a vessel that could only be grafted after an endarterectomy.

Continuous variables were expressed as mean±standard deviation (SD) with 95% confidence intervals (CI). Student' t-test was used to compare means, and Fisher's exact test was used for categorical data. SPSS 13.0 (Chicago, IL) was used for computation. Statistical significance was accepted at a level of $p<0.05$.

Results

Patient characteristics

The surgical intervention rate for CABG rose from 7.8/10,000 population/year in 2000 to 12.2/10,000 population/year in 2004 and subsequently fell to baseline levels in 2007, remaining fairly stable over the last two years (figure 1b). These figures include all patients undergoing CABG by all surgeons in our unit. In 2009 the PCI rate reached 18.8/10 000 population/year.

The mean age increased from 60.3±8.7 years, CI 1.00 in the early series, to 63.8±8.6, CI 0.99 ($p<0.001$) in the recent series(Table 2).

Patients over 70 made up 14.3% of the early series and 29.1% of the recent series (an increase of 103.5%, $p=0.001$); patients over 75 made up 3.1% of the early series and 11.2% of the recent series (an increase of 261.3%, $p=0.001$).

Octogenarians undergoing CABG went from 0 to 1.9% ($p=0.015$).

The proportion of females increased from 15.1 to 18.6% of the total coronary surgical population. This equates to an absolute increase of 23.2%, and was not statistically significant, $p=0.293$.

Vessel characteristics

The mean number of grafts per case fell from 3.24±0.96, CI 0.11 to 3.02±1.12, CI 0.13 ($p=0.010$). Figure 2 shows the graft distribution per case. In the early series, triple and quadruple grafts were the commonest operations. In the recent series triple and double grafts were the commonest, with significantly more double grafts and triple grafts and significantly fewer quadruple and quintuple grafts than in the early series.

Table 1: *Vessel characteristics at the site of anastomosis*

Calibre		*Quality*	
c1	>3mm	q1	normal
c2	2-3mm	q2	significant atheroma
c3	1-2mm	q3	calcified plaques
c4	>1mm	q4	requiring endarterectomy

Figure 3a shows the calibre distribution in the two series, with significantly fewer c1 vessels (over 3mm diameter) in the recent series. The mean calibre score declined from 2.13 to 2.18 ($p=0.06$). Figure 3b shows the quality distribution with significantly fewer q1 (normal) vessels and significantly more q2 vessels (significant atheroma at the site of anastomosis) in the recent series. The mean quality score showed a worsening from 1.23 to 1.30 ($p=0.001$).

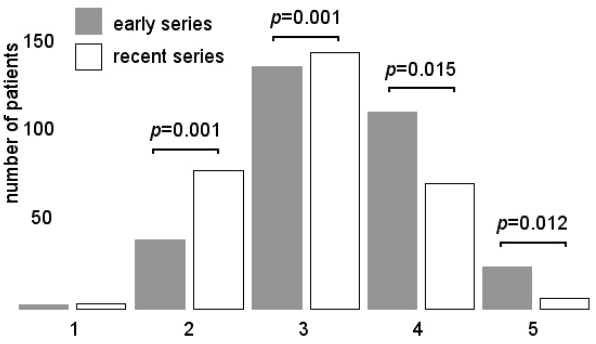
Discussion

In this paper we studied patients from 2000 when our cardiac catheeriszation laboratory first recorded data in digital format. This enabled an accurate calculation of ejection fraction for the purposes of risk stratification. In that year we adopted the euroSCORE[6] risk stratification system, supplementing the

Table 2: *Patient characteristics.*
Continuous variables expressed as mean ± SD

	Early Series	***Recent Series***	***p value***
mean age	60.3±8.7	63.8±8.6	<0.001
patients >70	14.3%	29.1%	0.001
patients >75	3.1%	11.2%	0.001
patients >80	0	1.9%	0.015
females	15.1%	18.6%	0293
mean grafts	3.24±0.96	3.02±1.12	0.010

Figure 2: *Number of grafts per case*



former Parsonnet[7] system with a more accurate and relevant one. Over a 14 year period (1995-2009) records from our database show that mortality was 25% of that predicted by Parsonnet and 46% of that predicted by euroSCORE. Thus the latter, newer system approximates more closely our surgical population. Patient data, an important component of risk stratification, correlates well with surgical outcomes in large series. The July 2008 starting date for the recent series was chosen in order to minimise any influence of the 2007 migration to Mater Dei Hospital.

Another important aspect of surgical treatment is the actual application of grafts in order to effect revascularisation. The difficulty encountered in this procedure has not been studied previously. We collected data prospectively and compared the characteristics of the vessels we grafted. The classification we devised has proven to be simple to apply and reproducible over time. Figure 4 illustrates a c2, q1 vessel before arteriotomy. The coronary artery lacks any visible characteristics of an inflammatory process or of calcification over the entire length of its epicardial course. Figure 5a illustrates a c2,q3 vessel after arteriotomy, exhibiting extensive calcification, making grafting a major technical challenge. The vessel immeditely proximal and distal to the arteriotomy displays the epicardial characteristics of severe disease with inflammation and marked calcification. Figure 5b illustrates its corresponding angiogram. In times when more rigid selection of patients was practiced such cases were not assigned to surgical treatment.

Ultimately the long-term graft patency depends on the run-off distal to the anastomosis as well as the completeness of the revascularisation procedure[8]. Our surgical strategy is to graft all major significantly diseased vessels. In a surgical population the number of grafts we were able to perform reflects the suitability of that population for surgical treatment. A lower mean graft per case figure describes a worsening population.

There was no significant difference in number of c2, c3 and c4 vessels grafted in the recent series. There were, however, significantly fewer c1, or vessels over 3mm diameter. In general vessels of <1mm calibre (c4) were only grafted when there was no other option. Similarly, all efforts were made to avoid endarterectomy (q4), a goal that was achieved in the recent series.

Risk stratification influences vessel characteristics. Certain demographic parameters, which contribute to the Parsonnet score, like diabetes, and others, which contribute to both

Figure 3a: *Calibre distribution of grafted vessels*

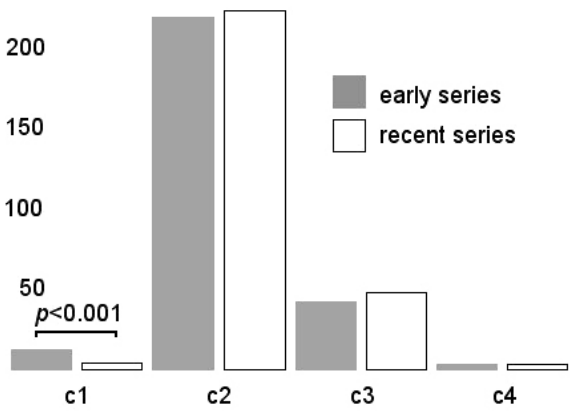
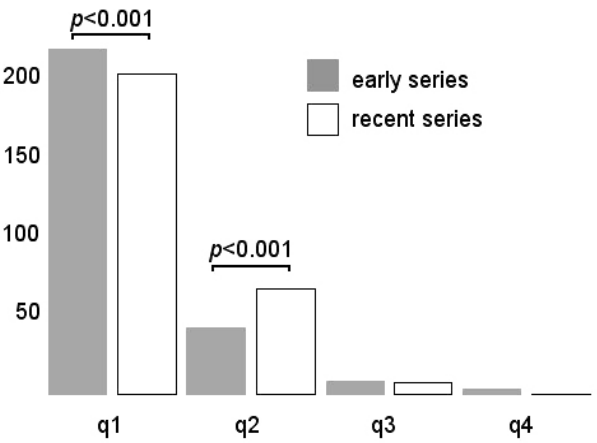


Figure 3b: *Quality distribution of grafted vessels*



Parsonnet and euroSCORE, like female gender and advancing age, are known to affect vessel calibre and quality. Thus, females undergoing CABG surgery have greater operative mortality compared to men and also tend to have more co-morbid factors, such as diabetes and hypertension.[9] Women also have a smaller body surface area, smaller coronary arteries, are older at the time of surgery, have a higher prevalence of urgent or emergency surgey,[10] and in some studies have been shown to receive fewer internal mammary grafs.[11] Female patients increased by 23.2% in the recent series.

Age is the single most important contributor to ris.[1, 13]. The mean age gives an incomplete picture of our surgical population. More relevant is the percentage of patients over 70, over 75, and over 80, all groups having increased significantly. Octogenarians were not considered for CABG in the early series but now make up 1.9% of our recent serie.

Conclusion

In a relatively short space of 8.5 years we have seen a dramatic change in our standard surgical practice, mirroring

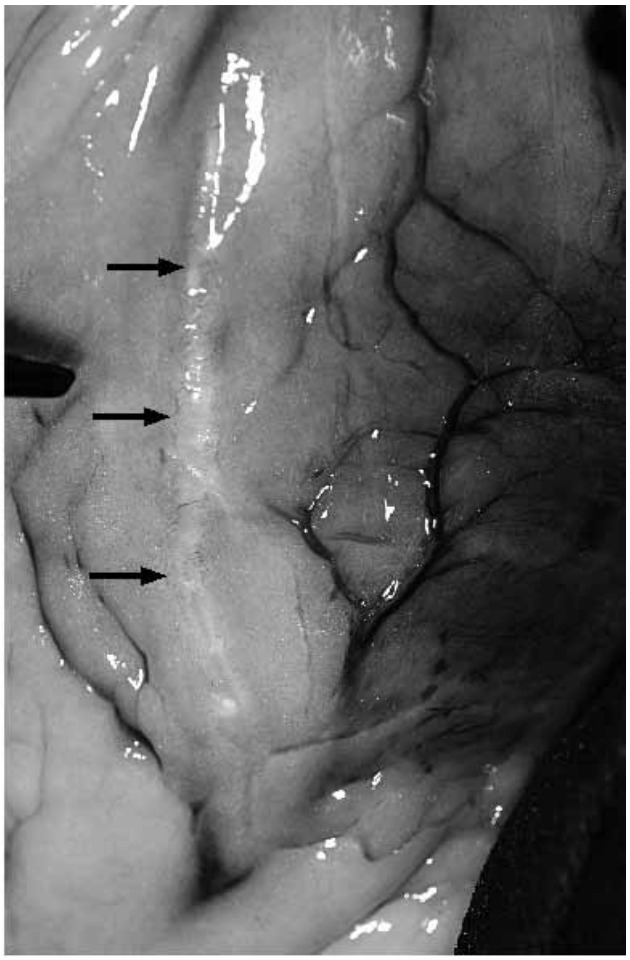


Figure 4: *A c2, q1 vessel before arteriotomy*

Figure 5a: *A c2, q3 vessel after arteriotomy*

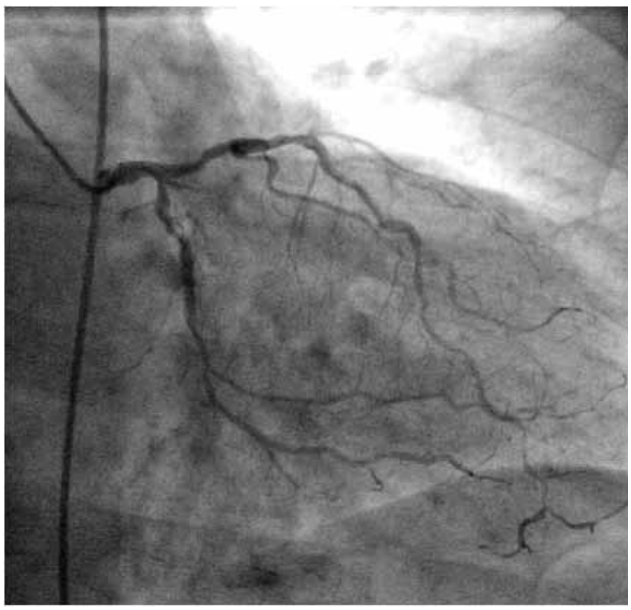


Figure 5b: *Angiogram of vessel depicted in figure 5a*

trends that are widespread in developed countries. These changes have been prompted by the dramatic development of PCI, mainly directed at coronary artery disease. The recent introduction of percutaneous procedures dealing with valvular heart disease will further add to the ongoing debate on the future of cardiac surgery and its implication for training residents in this speciality.

References

1. Lytle B, Mack M. The future of Cardiac Surgery: The Times, They Are a Changin'. Ann Thorac Surg. 2005;79:0-142.
2. Hannan EL, Wu C, Walford G, et al. Drug-eluting stents *vs.* coronary-artery bypass grafting in multivessel coronary disease. N Engl J Med. 2008;358331-31.
3. Hannan EL, Racz MJ, Walford G et al. Long-Term Outcomes of Coronary-Artery Bypass Grafting versus Stent Implantation. N Engl J Med. 2005;352:74-283.
4. The Syntax Trial investigators. Percutaneous Coronary Intervention versus Coronary-Artery Bypass Grafting for Severe Coronary Artery Disease. N Engl J Med. 2009;360961-72.
5. Taggart DP. Surgery is the best intervention for severe coronary artery disease. BMJ. 2005;33085-7
6. Nashef SAM, Roques F, Michel P, Gauducheau E, Lemeshow S, Salamon R. European system for cardiac operative risk evaluation (EuroSCORE). Eur J Cardiothoracic Surg. 1999;16:913.
7. Wynne-Jones K, Jackson M, Grotte G, Bridgewater B, North W. Limitations of the Parsonnet score for measuring risk stratified mortality in the north west of England. Heart. 000; 8(1) 7178.
8. Bell MR, Schaff HV, Holmes DR et al. Effect of completeness of revascularization on long-term outcome of patients with three-vessel disease undergoing coronary artery bypass surgery. A report from the Coronary Artery Surgery Study (CASS) Registry. Circulation. 1992;86446-57.
9. Mikhail GW. Coronary revascularisation in women. Heart. 2006 May; 92(Suppl.
10. Mickleborough LL, Carson S, Ivanov J. Gender differences in quality of distal vessels: effect on results of coronary artery bypass grafting. J Thorac Vasc Surg. 2003;12650-58.
11. Kurlansky PA, Traad EA, Galbut DL, Zucker M, Eet al. Efficacy of single versus bilateral internal mammary artery grafting in women: a long-term study. Ann Thorac Surg. 2001;71:194957.
12. Rosborough D. Cardiac Surgery in elderly patients. Critical Care Nurse. 2006;26:24-1.
13. Manché A. Cardiac Surgery in the elderly. Bold. 001; (11)4:8