Anaesthesia for vascular procedures: *How do South African patients differ?*

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ABSTRACT
South African vascular anaesthetic practice is strongly influenced by European and American literature. This is inappropriate, as the prevalence and aetiology of cardiovascular disease, the aetiology of the vascular pathology, and the vascular surgical outcomes in South African patients differ from those reported internationally. South African vascular surgical patients are at higher cardiac risk and have a higher mortality than that reported in the international literature.

Although cardiac clinical risk predictors are probably consistent globally, the epidemiological transition of cardiovascular disease and the socioeconomic consequences of apartheid have had a profound influence on the 'weighting' of these risk factors in South Africans. Of the South African race groups, South African Indians have the highest cardiac mortality, secondary to a high prevalence of renal dysfunction, diabetes and cerebrovascular accidents. South African black patients now have a similar cardiovascular burden to that reported internationally. The perioperative cardiac mortality of black South Africans is lower than international comparisons, probably secondary to a cardioprotective lipid profile of these patients. Black South Africans have an unacceptably high non-cardiac mortality associated with vascular surgery. Access to medical therapy for South African vascular surgical patients is wholly inadequate, as only a quarter of vascular patients are on statin therapy.

Nearly 6% of South African vascular patients present with Human Immunodeficiency Virus (HIV) vasculopathy of predominantly two distinct clinical presentations: aneurysmal and occlusive vascular disease. Aneurysmal disease is associated with a worse long-term prognosis. The poor access to highly-active anti-retroviral therapy (HAART) for these patients is unacceptable.

It is imperative that practice guidelines based on South African epidemiological data be established, that clinical cardiac and HIV risk indices be developed specifically for South African vascular patients, that socioeconomic issues affecting outcome between race groups be addressed, and that access to statin therapy and HAART be improved.

Introduction

Four of the five leading causes of mortality in South Africa include Human Immunodeficiency Virus (HIV) infection, ischaemic heart disease, stroke and interpersonal violence.[1] South African vascular surgical disease encompasses all these conditions in the three broad categories of 'traditional' atherosclerotic, HIV-associated and trauma-related vascular pathology. This review covers specifically atherosclerotic and HIV vasculopathy.

Vascular surgery is classically the epitome of increased cardiac risk following non-cardiac surgery. Due to the high prevalence of atherosclerotic disease in these patients, the majority of studies examining cardiac risk and cardiac outcome in non-cardiac surgery are conducted in these patients. South African anaesthetic practice is strongly influenced by these predominantly European and American studies. Unfortunately, there is surprisingly little literature which specifically addresses the cardiovascular risks associated with surgery for South African vascular surgical patients. The result is that one is forced to prognosticate and initiate medical and surgical therapy according to international risk indices and international trial outcomes.[2,3]

However, this review will show that basing South African practice on European and American studies is inappropriate, as the prevalence and aetiology of cardiovascular disease, the aetiology of the presenting vascular pathology, and the vascular surgical outcomes in South African patients differ from those reported in the international literature.

Methods

In order to address these issues adequately, the published literature is reviewed and additional unpublished data is presented. The unpublished data was collected with full local ethical approval for a study of cardiac risk in South African vascular surgical patients.[4]

This review requires consideration of race. The following race groups are discussed: black South Africans, white South Africans (who are predominantly of European descent) and Indian South Africans (who are predominantly of Asian Indian descent). At times in this review, other race groupings are used according to the study discussed and race classification used in the particular study.

Statistical analyses

SPSS 15.0 for Windows (6 Sept 2006) and Epicalc 2001 Version 1.2 (1998) were used for data analysis. All categorical data were analysed using descriptive statistics and either the Fisher's exact test or Pearson's chi-square test where appropriate. The distribution of demographic variables was analysed. Levene's test for equality of variances was conducted, before comparing independent data using an ANOVA test. A Bonferroni post hoc test was done for each possible pairwise comparison.

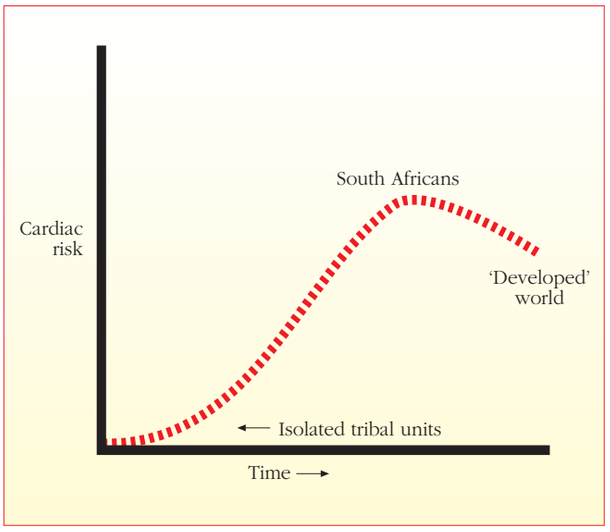
The epidemiological transition of cardiovascular disease

A process of epidemiological transition has been described to illustrate the evolution of cardiovascular risk in a population

over time.[5] Healthy isolated tribal units are initially exposed to a transition phase associated with disease and famine. However, as pandemics decrease, cardiovascular disease increases until such time that it predominates.[5] There may be a final phase of a partial decrease in cardiovascular risk secondary to increasing health awareness, appropriate surveillance and management of cardiovascular risk factors.[5]

South Africans are probably now at the point of degenerative and man-made cardiovascular disease, while developed countries (from which cardiac clinical risk indices[6-9] are derived) are probably now in the phase of decreasing cardiovascular risk, secondary to increased health awareness and surveillance. Therefore, South African vascular surgical patients are probably at a higher cardiovascular risk than American or European patients. Thus, the cardiac risk in the South African population may be higher than currently accepted cardiac clinical risk indices predict.[7,9] Indeed, cardiovascular disease is now the leading cause of death in all developing countries, with the exception of sub-Saharan Africa, where it is displaced by HIV infection.[5] The process of epidemiological transition of cardiovascular disease is illustrated in Figure 1.

Figure 1. Epidemiological transition of cardiovascular disease



Increasing cardiac risk associated with epidemiological transition is well illustrated if one considers two publications of peripheral arterial disease in black South Africans published eight years apart (See Table I).

Table I: The incidence of cardiac risk factors in black South African hospital patients with peripheral arterial disease: an illustration of epidemiological transition

Risk factors	1980 and 1998 cohort[10]	2007 cohort[11]
Hypertension	14%	75%
Diabetes	9%	30%
Ischaemic heart disease	5%	Not reported
Smoking	60%	60% (Male): 11% (Female)
BMI > 30 kg.m^{-2}	Not reported	38%

BMI: body mass index

The cardiovascular burden in South Africans

INTERHEART is an international, standardised, case-control study conducted in 52 countries to establish cardiovascular risk factors associated with acute myocardial infarction (AMI).[12,13] The African arm of the INTERHEART study (of which 80% of the patients were South African) allows one to quantify the cardiovascular burden in sub-Saharan Africa. Five risk factors in the INTERHEART Africa study account for nearly 90% of the risk associated with first-time AMI. These include a history of smoking, diabetes, hypertension, abdominal obesity and the ratio of apolipoprotein B to apolipoprotein A-1.[13] All these risk factors were also identified as independent predictors of AMI in the global INTERHEART study.[12] Thus, these risk factors are consistent throughout the world, across all continents and race groups.

However, the African INTERHEART study shows that the cardiovascular burden is significantly greater in sub-Saharan Africa in comparison to that reported globally. Hypertension and diabetes were more important risk factors for AMI in comparison to the global INTERHEART study (odds ratio [OR] 3.44 versus 2.49 and OR 3.55 versus 3.07 respectively). Hypertension and abdominal obesity were significantly stronger risk factors in the African INTERHEART study when compared with the global study. In fact, with the exception of smoking, all other risk factors had a higher OR in the African study when compared to the global INTERHEART study.

This study strongly suggests that the cardiovascular burden in sub-Saharan Africa may well be larger due to uncontrolled/undiagnosed/poorly managed major cardiovascular risk factors,[13] which is consistent with what one would expect from our understanding of epidemiological transition.[5]

The variation in cardiovascular risk between South African race groups

There are proponents of a race (or genetic) propensity to cardiovascular disease[14] and others who claim that the genomic influence on cardiovascular disease is minimal in comparison to 'environmental effects' associated with ethnicity.[15] These 'environmental effects' in essence refer to the socioeconomic situation associated with a particular race group in a particular country. In South Africa, as a result of apartheid, the socioeconomic influences on cardiovascular disease are potentially profound when considering different race groups and their associated risk of cardiovascular disease. These factors include (amongst others) education, income and access to primary health care.

If genetic racial factors were clinically important, these genetic factors should result in different cardiac risk factors being reported between different race groups. This is not the case. In the African INTERHEART study, the risk factors associated with AMI were similar to those of the rest of the world. They were also independently predictive in the three race categories defined in this study, namely black Africans, coloured Africans and European or other Africans.[13]

However, the 'weighting' of each independent risk factor associated with AMI is not necessarily the same as that reported in the global INTERHEART study, both for the sub-Saharan African population as a whole, and even between race groups.[13]

Black Africans in the INTERHEART study

Hypertension and abdominal obesity in black Africans result in a significantly higher risk of AMI than the overall INTERHEART results.[13] Black Africans have a significantly higher risk associated with hypertension. A history of cerebrovascular accident suggests a particularly high-risk group of black South Africans, with documented coronary artery disease being significantly higher than controls.[16]

The risk of AMI increases in black Africans with higher income and education.[13] This has recently been confirmed in the THUSA study.[17] Currently, high-income black South Africans are probably

Table II: Peripheral arterial disease in South African patients

	Year of RSA data	All race groups	White	Indian	Black	First-world data (significance compared to RSA data)
Prevalence	2007				29% over 50 years	4.5% to 29% over 50 years[36-38]
Aetiology[10,21]	1980–1998					
Atherosclerosis			97–98%	91%	85%	
Arteritis			0.5–0.6%	1%	10%	
Other			1.4–2.6%	8%	5-6%	
Presentation (Biccard, unpublished)*						
Mean age (±1SD)	2003–2006	60.5 (±10.2)	64 (±10.1)	61.9 (±9.6)	56.7 (±10.1)†	67.8 ± 11.1 (P<0.000001)
Male: Female		69%	80%	62%	74%‡	75%
Occlusive: Aneurysmal[10,21]	1980–1998	4:1	7:3	9:1	5:1	
Clinical presentation[21]	1980–1998					
Aortic aneurysm		11%	18%	7%	11%	
Aorto-iliac		42%	31%	41%	42%	
Extracranial cerebrovascular		19%	31%	26%	19%	
Fem-popliteal		28%	20%	26%	28%	
Cardiac clinical risk predictors[4] (Biccard, unpublished)*	2003–200					
Ischaemic heart disease		58%	67%	69%	31% ‡	25.6% (P<0.000001)
Congestive heart failure		1.7%	3.5%	1.3%	1.8% (NS)	3.8% (P<0.001)
Cerebrovascular accident		20%	14%	31%	10% †	13.5% (P=0.003)
Creatinine >180 μmol.L^{-1}		10%	3%	15%	6% †	3.6% (P<0.001)
Diabetes		36%	18%	55%	20% †	11% (P<0.000001)
Hypertension		66%	74%	78%	48% ‡	36.7%[9] (P<0.000001)
Smoking history		64%	74%	58%	63% ‡	
Lee's Revised Cardiac Risk factors[7] (Biccard, unpublished)†	2003–2006					
1		25%	22%	13%	44%	
2		34%	50%	26%	36%	
3		29%	25%	40%	16%	
4		11%	25%	19%	3%	
Dyslipidaemia[10]	1999					
LDL-C			3.79	3.88	2.62	
HDL-C			0.89	0.79	1.02	
Cholesterol			5.51	5.33	4.04	
Statin therapy[4] (Biccard, unpublished)*	2003–2006	17%	27%	25%	2% (NS)	53%[25] (P<0.000001)
Perioperative mortality[4] (Biccard, unpublished)*	2003–2006					
All-cause		10.8%	11.3%	13.9%	5.8% ‡	6.7%[9] (P<0.01
Cardiac		4.4%	4.8%	7.2%	0.7% ‡	3.3% (P=0.2)
Non-cardiac		6.4%	6.5%	6.6%	5.1% ‡	3.3% (P<0.01)
Mean age of mortality (+ 1SD)[4] (Biccard, unpublished)*	2003–2006	64.2 ± 10.5	68 ± 8.0	64.6 ± 11.7	60.1 ± 7.4 (NS)	71.9 ± 12 years[9] (P<0.00001)

* Age ≥40 years; † p<0.001 between ethnic groups; ‡ p<0.05 between ethnic groups; NS not significant

in the phase of degenerative and man-made disease, yet with little surveillance and management of cardiovascular disease.

Black Africans also had a significantly lower risk associated with current smoking when compared to the global INTERHEART study. An undesirable atherogenic lipid profile was also significantly lower, in comparison to other ethnic groups in the African INTERHEART study.[13]

Coloured Africans and Africans of European descent in the INTERHEART study

Sub-Saharan individuals of European or other African descent have a lower cardiovascular risk associated with tertiary education and the highest income group, suggesting increased surveillance and management of cardiovascular risk factors. The income and educational associations of the coloured African INTERHEART group appears to be following the trend of the European or other African group.[13]

South African Indians

In South African Indians, risk factors associated with AMI differ according to the age at presentation. Older patients (>65 years) were more likely to present with hypertension, diabetes and a history of coronary artery disease as risk factors for acute coronary disease. In contrast, younger patients (<45 years) presented with a stronger smoking history and obesity, and a familial history of vascular disease as risk factors for acute coronary syndromes. All age groups had elevated cholesterol levels as a risk factor.[18]

'Traditional' atherosclerotic peripheral arterial vascular disease in South Africa

As sub-Saharan Africans and associated race groups appear to have a varying 'weighting' for cardiovascular risk factors, it is important that one considers the prevalence, aetiology, cardiovascular burden and outcomes associated with surgical vascular disease in South African patients, and compares these to developed or 'first-world' studies on which the majority of South African practice is based (see Table II).

Presentation and aetiology of surgical vascular disease in South Africans

The prevalence of peripheral arterial vascular disease is high, even in rural black South Africans.[11] The aetiology of the vascular disease appears to differ between South African race groups, with almost all white South African patients having atherosclerotic disease, 10% of black South African patients having larger-vessel arteritis and 8% of South African Indian patients having non-arteritic lesions such as fibromuscular dysplasia, elastoses and congenital lesions.[10] The larger-vessel arteritis includes HIV vasculopathy (which will be discussed later), Takayasu's, syphilis, tuberculous and intimo-medial mucoid degeneration.[10]

The age of presentation in South African patients is significantly younger than international comparisons. In addition, the age of presentation varies between race groups, with a surprisingly young presentation for black South Africans. Vascular disease is predominantly occlusive in black South Africans, with relatively more aneurysmal disease in white South Africans. More than 50% of white South Africans present with aortic aneurysms and extracranial cerebrovascular disease, whereas aorto-iliac and fem-popliteal disease predominates in black South Africans. South African Indians have a similar prevalence of aorto-iliac disease and fem-popliteal disease to black South Africans, but have more extracranial cerebrovascular disease.

The cardiovascular burden of South African vascular patients

Consistent with epidemiological transition, the prevalence of cardiac clinical risk predictors in South African vascular surgical patients are significantly higher than those reported in European vascular patients[9] (see Table II), with the exception of congestive cardiac failure. This occurs despite the fact that South African patients undergo vascular surgery at a significantly younger age than developed world comparators. It appears, therefore, that the cardiovascular burden is significant across all South African racial groups.

South African Indians

Examination of the race groups in Table II shows that the cardiovascular burden is highest in South African Indian patients, followed by white and then black South Africans (the mode for the number of Lee's cardiac risk factors[7] per patient is three, two and one risk factor respectively). Cardiac mortality in South African Indians is 1.5 times more common than in white South Africans and 10 times more common than in black South Africans. This is in spite of a lower prevalence of male gender at presentation among South African Indians.

Why are South African Indians at such high cardiac risk? This may be explained in part by the cardiac clinical risk factors at presentation and their prevalence. Renal dysfunction, diabetes and a history of cerebrovascular accident are fivefold, threefold and twice as common respectively when compared with white South Africans. These three risk factors were associated with the highest risk of cardiac complications in the derivation cohort of Lee's Revised Cardiac Risk Index.[7]

An elevated serum creatinine is a particularly important predictor of cardiac morbidity. It was found to have the highest relative risk of major cardiac complications following non-cardiac surgery in the derivation cohort of the Revised Cardiac Risk Index with an OR (95% CI [confidence interval]) of 3.0 (1.4-6.8),[7] and the second most important clinical predictor of all-cause mortality after a history of cardiac failure in the validation cohort in a Dutch population.[9] Similarly, in South African vascular surgical patients, renal dysfunction was a significant independent predictor of cardiac death – OR (95% CI) of 3.0 (1.1-8.6).[4]

Of all race groups, diabetes was most prevalent in South African Indians (see Table II). This was also shown for every age cohort examined in the South African Burden of Disease Study conducted in 2000.[1] Among South African Indians the prevalence of diabetes is equal between males and females, in comparison to other race groups where it is significantly higher in females.[1] About a third of diabetes sufferers die as a result of ischaemic heart disease, hypertension, stroke and renal failure.[1] Importantly, the mortality associated with diabetes in South Africa is also higher than would be predicted from the prevalence of the disease, when compared with global figures. This is attributed to poor glycaemic control, poor monitoring for associated complications, inadequate hypertensive management and little use of lipid-lowering therapy.[1] Indeed, South African Indian surgical vascular patients epitomise this scenario, with a 78% prevalence of hypertension (the highest of all race groups), a dyslipidaemic profile similar to white South Africans and only 25% of patients receiving statin therapy.

In South Africa, cerebrovascular accidents and ischaemic heart disease account for approximately 50% and 40% respectively of hypertensive deaths.[19] The high prevalence of a history of cerebrovascular accident in South African Indian vascular patients may be a reflection of poor hypertensive management. Hypertension is the second highest risk factor for mortality in South Africa (after HIV) and cerebrovascular accidents are the third highest disease associated with mortality in South Africa (after HIV and ischaemic heart disease).[1]

Finally, although the lipid profiles of white and Indian South African vascular surgical patients appear similar, mortality associated with dyslipidaemia is higher among South African Indians.[20]

Black South Africans

Black South African vascular surgical patients have an unusual presentation. They present at the youngest age of all South Africans, with predominantly occlusive disease (70% present with either aorto-iliac or fem-popliteal disease). Their

cardiovascular risk burden is thus not surprisingly the lowest of all the South African population groups. However, it must be emphasised that although black South Africans appear to have the lowest cardiovascular burden (in South African terms), when compared to a Dutch vascular surgical population[9] their cardiovascular burden is similar to this international comparator (see Table II). However, the cardiac mortality of black South Africans appears to be less than reported in the Dutch cohort.

What may be partly responsible for this 'relative cardioprotection' is that the lipid profile of black South Africans is the most desirable of all population groups. Black South Africans have the lowest attributable mortality associated with dyslipidaemia of all South African population groups.[20] As observed in our South African vascular surgical patients, this may be secondary to some protection from a HDL cholesterol to total cholesterol ratio higher (i.e. more cardioprotective) than that of other race groups.[20] It is possible that this scenario will change in the foreseeable future, as the difference in lipid profiles between black and other race groups is most marked in the elderly (similar to the vascular patients presented in Table II), and not nearly as marked in younger individuals.[20] This suggests that socioeconomic factors may quickly be changing the cardiac risk profile of younger black South Africans.

The predominantly occlusive presentation of black vascular surgical patients has also been suggested to represent a process of epidemiological transition associated with atherosclerotic vascular disease, with an increase in aneurysmal disease (as seen in the white South African population) characteristic of a more advanced atherosclerotic process.[21] The real conundrum is why then do black South Africans present so early with vascular disease, although other traditional cardiovascular risk factors are less prevalent?

A disturbing observation is that although the cardiac mortality is lowest among black South Africans, the non-cardiac mortality is sevenfold higher than the cardiac mortality, while among the other race groups the cardiac and non-cardiac mortalities are similar.

Statin therapy in South African vascular surgical patients

Statin therapy could be considered a 'standard of care' for vascular surgical patients as it is suggested that all vascular patients should receive statin therapy.[22] A study of high-risk South African vascular surgical patients found only 22% of these patients to be on statin therapy prior to surgery.[23] This is similar to the prescription of statins between 1991 and 2001 in the Netherlands.[24] In the NCEPOD study of abdominal aneurysm surgery in the United Kingdom conducted over a two-month period in 2004, the incidence of statin therapy in elective patients was 53%.[25] Thus, statin prescription for South African vascular surgical patients is inadequate: it is about a quarter of the desirable therapeutic intervention rate,[22] and about half of the 'real' figures of a first-world country.[25]

However, one cannot merely look at the percentage of patients prescribed statin therapy when considering access to healthcare. Although a similar percentage of white and Indian South African patients are on statin therapy – as the Indian patients have a higher cardiovascular risk burden and a higher cardiac mortality – one would expect a higher proportion of Indian patients on statin therapy if access to medical care was equivalent.

Smoking and statins: a peculiar problem in South Africa

A study of South African vascular surgical patients found smoking to be an independent predictor of perioperative cardiac mortality.[4] A history of smoking has also been shown to be a significant risk factor associated with AMI in non-surgical South African patients.[13] Smoking is an independent predictor of elevated c-reactive protein,[26] and an elevated c-reactive protein is associated with vulnerable atherosclerotic plaque and acute coronary syndromes.[27] In contrast, statin therapy significantly decreases c-reactive protein levels.[26]

However, as discussed, statin therapy for South African vascular surgical patients is wholly inadequate. Smoking as a cardiac risk factor in South African patients is a classic example of the effect of the socioeconomic implications of poor primary health care and surveillance in South African patients, resulting in continued smoking and lack of statin therapy. Therefore, in South Africa a history of smoking is probably an important predictor of cardiac risk.[4]

The reported outcomes of South African vascular surgical patients

A Dutch vascular surgical study conducted between 1991 and 2000 reported a 6.7% and 6.5% 30-day all-cause mortality in the derivation and validation cohorts respectively,[9] compared to a 6.1% in-hospital all-cause mortality among South African vascular surgical patients between 2003 and 2006.[4] The reported cardiac mortality among South African vascular surgical patients was 1.7%,[4] which is similar to the 1.3% reported for patients at cardiac risk undergoing major non-cardiac surgery.[28] Similarly, cardiac death was attributed to AMI in 67% of patients in the South African study,[4] and 66% of patients in the predominantly American and European studies.[28]

However, if the analysis is conducted only on patients of age >39 years, in order to remove the majority of trauma (mean age of 28.7 (± 9.2) years) and HIV-related vascular patients (median age 30 to 40 years),[30-32] then the all-cause mortality rises to 10.8% and the cardiac mortality to 4.4% (see Table II) (Biccard, unpublished).

In addition to increased all-cause mortality among South African patients with predominantly atherosclerotic vascular disease, the age at death is significantly lower among South African patients ($P<0.00001$). The observed increased prevalence of cardiac risk factors among South African patients may partly explain the lower age of cardiac mortality among South African vascular surgical patients.[4]

Long-term outcome

There is little literature on the long-term outcome of South African vascular surgical patients. With an increased cardiovascular burden, one would expect a higher mortality than that reported in European and American literature. A study of peripheral vascular disease at Groote Schuur Hospital, Cape Town, showed that mortality was 19.2% at two years.[33] The median age was 62 years, with 49% prevalence of diabetes. This compares favourably with other American studies of patient cohorts not on statin therapy, although the prevalence of diabetes and age reported in these papers are higher than that reported in Cape Town.[34,35] It is difficult therefore to comment on the long-term outcome in South African vascular patients in comparison to American patients.

The implications of epidemiological transition for perioperative prognostication in South African vascular surgical patients

As the risk factors associated with AMI appear to be consistent globally,[12] it is likely that internationally derived cardiac clinical risk indices should correctly identify South African patients at risk. However, as these risk indices have not been validated in a South African population and there is good evidence that the 'weighting' of risk factors associated with AMI varies between sub-Saharan Africans (and even between South African race groups) when compared with that reported globally,[13] it is unlikely that published cardiac clinical risk indices will correctly prognosticate cardiac outcome in a South African population.

Although Lee's Revised Cardiac Risk Index (RCRI)[7] has been found to be significantly better than previous risk indices at predicting cardiovascular complications[39] and it has also been validated outside of its derivation population,[40] it would appear to underestimate risk in South African vascular surgical patients (See Table III).

Table III: All-cause mortality in vascular surgical patients associated with Lee's Revised Cardiac Risk Index

CVS risk factors (N)	30-day all-cause mortality in vascular patients (Dutch)	In-hospital cardiac mortality in vascular patients (South African) (Biccard, unpublished)[4]
0		
1	0.3 %	2.8%
2	0.7 %	4.4%
3	1.7 %	4.6%
4	3.6 %	8.6%
5		25%

CVS: cardiovascular. Clinical risk factors include high-risk surgery, ischaemic heart disease, history of congestive cardiac failure, history of cerebrovascular disease, insulin therapy for diabetes, and a preoperative serum creatinine of >177 μmol/L.

Similarly, it is likely that there may be important race differences associated with prognostication and the number of Lee's RCRI[7] risk factors. This is an area which needs further research in South Africa.

HIV vasculopathy

Since 2002, 5.7% of patients presenting to a Pretoria vascular surgical unit were HIV positive.[30] Of the patients with HIV-associated vasculopathy, 26% present with aneurysmal disease, 69% with occlusive disease and 3% with arterio-venous fistula.[30] Vascular patients who are HIV positive appear to present two distinct clinical entities (aneurysmal or occlusive) with possibly different outcomes. The characteristics of patients with HIV vasculopathy presenting for surgery are presented in Table IV.

Table IV: Characteristics of HIV-related vascular disease in South African patients[30-32,41]

	Aneurysmal	Occlusive
Median age	30 to 39.3 years	37 to 40.7 years
Mean CD_4 count (± 1SD)	323.2 (79–916)	300.2 (15–926)
Most common presentation	Internal carotid artery	Fem-popliteal segment
Perioperative mortality	4% to 10.6%	0% to 3.6%
Long-term mortality (46 months)*	50%	26%

* $p<0.05$

Although the perioperative mortality was not significantly different between patients with occlusive and aneurysmal pathology, mortality over 46 months was significantly worse (p=0.049) for patients with aneurysmal disease. None of these patients were on highly active anti-retroviral therapy (HAART). Importantly, the CD_4 count was not associated with mortality (p=0.227). Patients with HIV vasculopathy appear to have a low incidence of traditional cardiovascular risk factors, with a reported incidence of hypercholesterolaemia of 2%, diabetes of 2% and hypertension of 21%, but a similar incidence of smoking to that of atherosclerotic vascular patients.[30] Therefore, the use of cardiac risk indices alone to prognosticate is probably inappropriate in these patients.

In American HIV-positive patients on HAART presenting for abdominal aortic surgery, independent predictors of postoperative morbidity included hypoalbuminaemia and a CD_4 <200 μL.[42] Myocardial infarction and congestive cardiac failure were reported in 6.8% of patients, and all-cause in-hospital mortality in 15% of patients. Unfortunately, the prevalence of cardiovascular risk factors was not reported in this paper. Postoperative sepsis is common, reported as 10% in American patients.[42] In these patients on HAART, long-term survival was not significantly different between patients with aneurysmal and occlusive vascular disease, contrary to the South African experience with no patients on HAART.[30] Caution is advised in applying this data to South African patients, as the majority of the patients in the American study were HIV positive as a result of intravenous drug addiction, which presents a different patient profile to that of South African HIV positive vasculopaths.[30]

Principles for vascular anaesthetic practice in South Africa and future research agendas

Practice based on international reported perioperative outcomes

Clearly it is inappropriate to adopt American and European practice recommendations based on perioperative surgical outcomes reported in their literature, as it is likely that morbidity and mortality for similar procedures in South African vascular surgical patients will be higher, secondary to epidemiological transition and an increased cardiovascular burden.

To illustrate this point, one should consider the issue of carotid endarterectomy. The European Cardiac Surgery Trial (ECST) reported a 30-day combined major stroke and surgical death event rate of 6.8% for the whole study, and 4.5% for patients with carotid stenosis of 80 to 99%.[3] However, if one compares the prevalence of hypertension (52%), ischaemic heart disease (24%) and diabetes (12%) to the patient cohort reported in Table II, South African vascular surgical patients have significantly more hypertension, ischaemic heart disease and diabetes (66%, 58% and 36% respectively, $p<0.000001$ for all comparisons). In summary, it would be unrealistic to expect perioperative outcomes similar to those reported in the ECST.

Rather, one should accept that the ECST shows that carotid endarterectomy is indicated in patients with carotid stenosis >80% and symptomatic cerebrovascular disease. An acceptable event rate for this procedure in the South African population needs to be established. Similarly, it is likely that the long-term morbidity and mortality is higher than those reported in ECST in South African patients who are managed medically. It is of paramount importance that data on South African event rates for accepted vascular surgical procedures are gathered. This would help in the establishment of acceptable practice guidelines for South African patients.

Perioperative cardiac risk prognostication

Established risk indices, such as Lee's RCRI,[7] need to be validated in a South African population so that one can improve prognostication for patients.

One also needs to take cognisance of the socioeconomic factors which contribute to cardiac risk in South African vascular surgical patients, and attempt to include these in cardiac risk indices to account for the variation of the epidemiological transition of cardiovascular disease between race groups.

Black South Africans

The aetiology of the high prevalence of non-cardiac deaths in these patients needs to be determined.

HIV

Predictors of outcome in South African HIV-positive patients need to be determined. The work by Lin and colleagues suggests that factors that need to be considered when conducting a study of this nature include the number of anti-retroviral drugs, the duration of anti-retroviral therapy, renal dysfunction, hypoalbuminaemia and the CD_4 count.[42] In addition, the surgical presentation of the HIV vasculopathy should be considered.[30]

Standards of care

It is imperative that systems that ensure that atherosclerotic

vascular patients have access to statin therapy, and that HIV vasculopaths have access to HAART are established.

Conclusion

Vascular anaesthesia in South Africa is confronted with serious practice limitations based on a reliance on literature derived from countries with a markedly different cardiovascular risk profile and associated socioeconomic situation. It is time for South African anaesthetists with an interest in vascular surgery to galvanise and form an interest group with the primary objective of addressing the issues raised in this paper, with a particular emphasis on the following: epidemiological data collection, derivation and validation of both cardiac and HIV risk indices for South African vascular surgical patients, inclusion of socioeconomic factors in prognostication, establishing realistic guidelines and outcomes for surgical intervention, and finally ensuring an acceptable standard of care and appropriate access to health care. **SAJAA**

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