ORIGINAL PAPER

IJCP THE INTERNATIONAL JOURNAL OF CLINICAL PRACTICE

Implementation of best medical therapy for cardiovascular risk factors in vascular surgery patients treated in a tertiary referral regional unit

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Presented at the Association of Surgeons of Great Britain and Ireland 2013 International Surgical Congress, Glasgow, UK, 1–3 May 2013 and at the Southern Association for Vascular Surgery, 15–18 January 2014, FL, USA.

Disclosure
None.

SUMMARY

Objective: Current clinical evidence reports that antiplatelet, statin, angiotensin-converting enzyme inhibitor and beta blockade therapies have advantageous effects on vascular surgery patient morbidity and mortality. Unfortunately, such patients appear to be less likely to receive optimal medical management when compared with coronary artery disease patients. This study assessed medical therapy prescribing in patients attending a regional vascular surgery unit. **Methods:** A retrospective review between February 2010 and February 2011 was performed for patients undergoing aortic aneurysm, carotid, peripheral arterial and amputation surgeries. Gender, age, smoking history, body mass index and cardiovascular risk factors were documented from inpatient charts. Current admission medications and subsequent modification by the vascular team were recorded. **Results:** Two hundred and forty-four patients (male = 165, mean age = 71 years) were identified. Prevalence of hypertension, hypercholesterolaemia, myocardial infarction, angina, stroke and diabetes was higher than in the general population. A total of 201 (82.3%) patients were on antiplatelets or antithrombotics upon admission to the vascular ward, which was improved to 231 (94.6%) patients on discharge. A total of 180 (73.7%) patients were on lipid-lowering therapy upon admission, which was improved to 213 (87.2%) patients on discharge. A total of 115 (47.1%) patients were on ACE-inhibitor or angiotensin 2 receptor blocker medications on admission and this was improved to 118 (48.3%) upon discharge. A total of 87 (35.6%) patients were on a beta-blocker, which was improved to 93 (38.1%) patients upon discharge. **Conclusion:** Despite increased implementation of best medical therapy in the community with compliance rates greater than 73% for aspirin and statin therapy, further improvement is warranted. Vascular surgeons should remain vigilant for further opportunities to optimise medical therapy in this high-risk patient group particularly with antithrombotic, lipid lowering and antihypertensive therapies.

What's known
The prevalence of atherosclerosis and subsequent cardiovascular pathologies is rapidly increasing as a result of an ageing population who are living longer. Despite improvements in the community, current primary care pharmacological strategies for these patients still remain suboptimal with current compliance rates of only 73% in this high-risk patient group.

What's new
Hospital admission for vascular surgery patients affords the clinician a unique controlled environment to optimise best medical therapy with antithrombotic, lipid-lowering and antihypertensive medication. We emphasise the need for close liaison with hospital physicians and community medical practitioners to further improve and also maintain patient compliance on discharge from the vascular surgery unit.

Introduction

The prevalence of atherosclerosis and subsequent cardiovascular pathologies is rapidly increasing as a result of an ageing population who are living longer. Risk factors clearly contributing to cardiovascular deterioration such as diabetes, hypercholesterolaemia, hypertension and smoking are amenable to lifestyle and pharmacological manipulation.

Both Cassar et al. and Hirsch et al. have suggested that current primary care management strategies for peripheral arterial patients (PAD) patients remain suboptimal compared with cardiovascular counterparts (1,2). Although Daskalopoulou et al. reported higher rates of antithrombotic and lipid-lowering therapy for patients with intermittent claudication compared with these earlier studies, compliance rates still remain lower than recommended levels (3). Unfortunately, information from the European Action on Secondary and Primary Prevention by Intervention to Reduce Events (EUROASPIRE) III survey also showed that implementation of guidelines for management of cardiovascular risk factors in patients with established coronary artery disease remains suboptimal (4). Perhaps, this relates to aged evidence as Sillesen noted that best medical therapy

evidence for carotid arterial disease was over 20 years old compared with more recent data from the effect of urgent treatment of transient ischaemic attack and minor stroke on early recurrent stroke (EXPRESS) Study where the 90-day stroke rate was reduced from 10.2% to 2.1% as a consequence of changing clinical practices, which minimised delays in the assessment, investigation and treatment of patients with symptomatic cerebral vascular disease. Sillesen further suggested that optimisation of medical therapy alone may have reduced the subsequent stroke rate by 85% (5).

Evidence from the Prospective Registry and Evaluation of Peripheral Arterial Risks, Events and Distribution Investigators' (PREPARED) cohort study, assessing 473 patients from 23 UK sites followed up over 2 years, has shown that tertiary care management is associated with an increased in the use of aspirin, statins and angiotensin-converting enzyme (ACE) inhibitors, as well as a significant reduction in systolic and diastolic blood pressures in patients with intermittent claudication. Multivariate analyses showed that increased age, prior coronary heart disease and diabetes were major contributors to death and composite risk of death, stroke and myocardial infarction (6). They concluded that specialist clinics designed to manage modifiable risk factors in this cohort would undoubtedly be associated with improved outcomes.

Although endovascular or surgical intervention is the only definitive management of abdominal aortic aneurysms (AAA), age, male gender, hypertension and smoking remain specific risk factors for aneurysmal prevalence and growth. Aggressive management of hypertension upon diagnosis of AAA is recommended, while pleotropic effects of low-dose aspirin and statin therapies on aneurysmal growth and subsequent interventions have also been reported (7–9). Although pre-operative statin and beta-blocker therapies have been shown to improve cardiac morbidity and mortality within 30 days of vascular surgery, modification in the angiotensin/renin system has failed to show conclusive direct benefits in the management of AAA. Current guidelines from the European Society for Vascular and Endovascular Surgery (ESVS) suggest that all AAA patients should be treated with antiplatelets, statins and beta-blockers (7).

The Scottish Intercollegiate Guidelines Network (SIGN) guidelines advise a full cardiovascular risk assessment for all PAD patients (10). The American Heart Association (AHA) and American College of Cardiology (ACC) guidelines support aggressive risk reduction therapies for secondary prevention in patients with established coronary and other atherosclerotic vascular disease including PAD, aortic and carotid artery disease (11). Such guidelines recommend complete cessation of smoking, lifestyle modification to reduce weight and improve physical activity, management of blood pressure (< 140/80 mmHg), lipid control (LDL < 100 mg/dl) and optimisation of glucose homeostasis (HbA1c < 7%) using antiplatelet and lipid-lowering therapies, beta-blockers and/or ACE inhibitors, as well as hypoglycaemic pharmacotherapy (10,11). Although caution is advised with beta-blocker therapy in critical ischaemia, it remains cardioprotective in patients with a history of coronary or peripheral arterial disease (12,13). The ESVS Guidelines reaffirm the need for aggressive management of secondary risk factors, with statin therapy recommended for patients with ischaemic stroke, transient ischaemic attack, asymptomatic carotid stenosis > 50%, and/or comorbid coronary artery disease with a target goal of LDL-C < 2.6 mmol/l. Antiplatelet therapy is warranted for patients with symptomatic and asymptomatic carotid artery stenosis. Although antihypertensive medications may individualise to patients, a preference for ACE inhibitors and calcium channel blockers, usually in combination, is suggested. In addition, all patients with carotid artery disease should be advised to quit smoking, avoid excessive alcohol intake, reduce weight if overweight or obese and advised regarding the benefits of increased physical activity (14).

The meta-analyses by the Antithrombotic Trialists' Collaboration in 2002 identified significant reductions in serious vascular events (25%), non-fatal myocardial infarction (34%), non-fatal stroke (25%) and mortality (15%) in vascular patients treated with aspirin, particularly those with PAD and carotid artery stenosis (15). The Cochrane review by Dorffler-Melly et al. further reported a 41% reduction in 12-month occlusion rates in patients treated with aspirin following lower limb revascularisation for PAD (16). Improvements in lipid homeostasis with statin therapy from numerous large, randomised controlled trials including the Scandinavian Simvastatin Survival Study (4S), Cholesterol and Recurrent Events (CARE) and West of Scotland Coronary Prevention Study Group (WOSCOPS) studies have demonstrated increased survival from coronary deaths in patients undergoing myocardial revascularisation procedures (17–19). Meta-analyses of the effects of lipid-lowering therapy in patients with PAD identified reduced disease progression and reductions in overall mortality when compared with placebo (20). It is postulated that the beneficial effects of statin therapy on vasomotor function, intraluminal thrombosis and atherosclerotic plaque formation relate to the reduction in arterial wall low-density lipoprotein deposition and improvements in

nitric oxide bioavailability, while the mevelonate pathway mechanisms reduce the production of isoprenoids, thus further improving the bioavailability of nitric oxide leading to anti-inflammatory effects (21–24).

Cardiovascular morbidity and mortality risk doubles for each blood pressure increment of 20 mmHg systolic or 10 mmHg diastolic between the ages of 40 and 89 years (25). Pleotropic cardioprotective effects of ACE inhibitors include restoration of the balance between myocardial oxygen supply and demand, reductions in left ventricular preload and afterload, left ventricular mass and sympathetic stimulation (26). Vasculoprotective effects include direct antiatherogenic, antiproliferative and antimigratory effects on smooth muscle cells, neutrophils and mononuclear cells, improvement and/or restoration of endothelial function, protection from plaque rupture, antiplatelet effects, enhancement of endogenous fibrinolysis, antihypertensive effects, and improvement in arterial compliance and tone (26). Yusaf et al. reported reductions in myocardial infarction, coronary revascularisation, heart failure, cardiac arrest, stroke and overall death rates in atherosclerotic patients treated with ramipril (27). ACE inhibitor therapy should be considered in patients with hypertension, diabetes, chronic kidney disease or those with a left ventricular ejection fraction of $\leq 40\%$ unless contraindicated (11).

Objectives

Despite recent advances in atherosclerotic management protocols, we hypothesised that higher risk vascular surgery patients admitted to hospital still had suboptimal control of their cardiovascular risk factors. The main objectives of this study were to evaluate cardiovascular risk profiles of patients admitted to a tertiary referral regional vascular surgery unit; to assess pharmacological therapy on patient admission; and to evaluate the proportion of patients who required optimisation of medical therapy during their hospital admission.

Methods

All patients undergoing a vascular surgery intervention at the regional vascular and endovascular unit in the Belfast City Hospital were assessed in this study between February 2010 and February 2011. Surgical caseload was identified through analysis of the Belfast Health and Social Services Trust Theatre Management System. Patients undergoing aortic aneurysm, carotid, peripheral arterial reconstruction and amputation surgeries were suitable for inclusion. Elective varicose vein surgeries, renal access procedures and other minor non-arterial procedures were excluded from the final analysis.

Patient demographics, mode of admission (elective vs. emergency) and hospital stay logistics were recorded for each patient. Past medical data including ischaemic heart disease, myocardial infarction, atrial fibrillation, angina (stable/unstable), hypertension, hypercholesterolaemia, diabetes (types 1 and 2), chronic kidney disease (requiring dialysis), cerebrovascular accident or transient ischaemic attacks and chronic lung diseases were collated from review of all clinical correspondence including previous admission and discharge documentation. Additional information regarding smoking history, height, weight and previous vascular interventions was also documented.

All current pharmacological therapies were recorded with particular attention to aspirin, clopidogrel, warfarin, beta-blocker, ACE inhibitors, angiotensin receptor blocker and statin therapies. All medications were assessed on admission, while any amendments to therapy, based on current guidelines from the ESVS, within 24 h of admission and within 24 h of discharge were recorded (7).

Results

Demographics

There were 729 operations performed on 613 patients within the regional vascular and endovascular unit in the Belfast City Hospital during the study period. The Belfast Health and Social Services Trust Medical Records Department provided 348 (56.8%) patient charts for review accounting for 416 (57.1%) operations. From these 348 patients, we excluded those undergoing varicose vein surgery ($n = 75$), fistula operations ($n = 10$), venous access procedures (portacath insertion and removal = 5), evacuation of haematoma secondary to trauma ($n = 2$), excision of cyst left hallux ($n = 1$), lymph node biopsy ($n = 1$) and carpal tunnel release ($n = 2$). A further eight patients had no records of the actual procedure documented in the notes and were subsequently excluded. A total of 244 patients were included in the final analysis comprising 165 male and 79 female patients with a median age of 71.0 years and admission length of stay of 18.1 days (Figure 1). Surgical caseload is detailed in Table 1.

Past medical history

One hundred and sixty-eight patients had a documented history of hypertension and 145 had hypercholesterolaemia. Sixty-seven patients had a history of stable angina, four with unstable angina, 57 had a previous myocardial infarction where 16 had

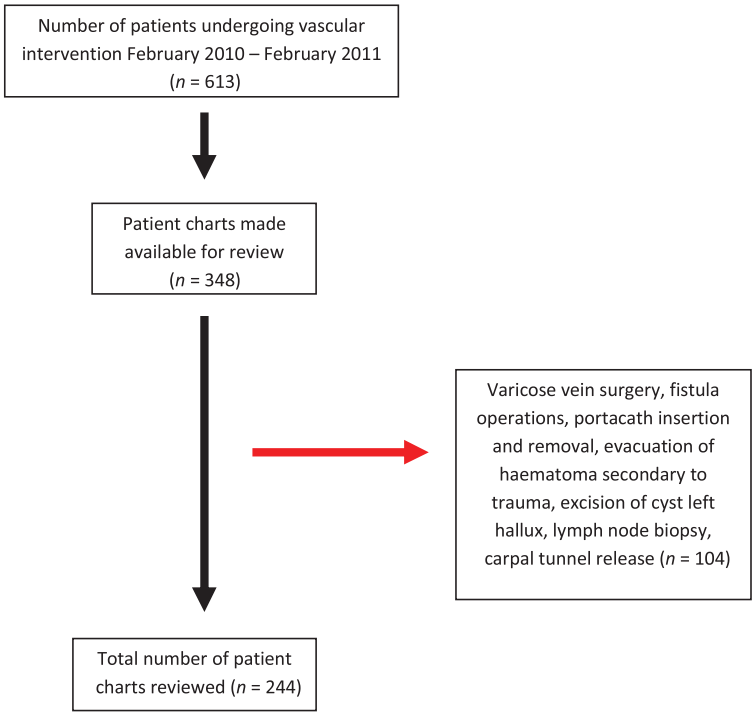

Figure 1 Study recruitment algorithm

Table 1 Patient demographics and procedures including nine (3.6%) patients who underwent a combination of procedures (AAA, abdominal aortic aneurysm; EVAR, endovascular abdominal aortic aneurysm repair)

Operative procedure	Total patients (%)	Male	Female	Median age (years)	Average stay (days)
Open AAA repair	30 (12.2)	25	5	72	26
EVAR	19 (7.7)	19	0	71	19
Carotid endarterectomy	27 (11.0)	15	12	71	19
Peripheral arterial reconstruction	78 (31.9)	54	24	72	18
Amputation	73 (29.9)	43	30	72	18
Miscellaneous	26 (10.6)	17	9	71	20

proceeded to previous coronary artery bypass grafting. Thirty-two patients had atrial fibrillation, while 21 had congestive cardiac failure. Twenty-three patients had chronic obstructive pulmonary disease, while 21 had a history of asthma. Thirteen patients had type 1 and 70 had type 2 diabetes mellitus. Forty-eight patients had chronic kidney disease with 15 currently requiring dialysis. Thirty-one had a history of cerebrovascular accident, while a further 33 described previous transient ischaemic attacks. Ninety-four patients surveyed had a history of previous vascular intervention. Five patients had a history of open AAA repair, 7 had a history of endovascular aortic aneurysm repair, 42 had a history of peripheral arterial reconstruction, 2 had a history of carotid endarterectomy, 33 had a history of amputation, 3 had a history of varicose vein surgery and 39 had a history of angioplasty. Thirty-seven patients had a combination of these procedures (Table 2).

Lifestyle measures

One hundred and eighty-nine (77.5%) patients had height and weight recorded. Sixty-nine (28.2%) patients had a body mass index between 18.5 and 24.9 and therefore would be considered within the normal range. Sixty-five patients were overweight (BMI 25–29.9), 34 were obese (BMI 30–34.9) and 13 were morbidly obese (BMI > 35). Eight patients had a BMI < 18.5. Therefore, 49.1% of patients assessed were considered outside the normal range where 45.9% were clinically overweight. Ten patients had documentation of weight but not height, and three patients had documentation of height but not weight. The remaining 42 patients had no documen-

Table 2 Past medical history (CABG, coronary artery bypass grafting; COPD, chronic obstructive pulmonary disease)

Comorbidity	Documented history	Percentage of patients
Myocardial infarction	57	23
CABG	16	7
Congestive cardiac failure	21	9
Atrial fibrillation	32	13
Stable angina	67	27
Unstable angina	4	2
Hypertension	168	69
Hypercholesterolaemia	145	59
Type 1 diabetes	13	5
Type 2 diabetes	70	29
Chronic kidney disease	48	20
Dialysis	15	6
Cerebrovascular accident	31	13
Transient ischaemic attack	33	14
COPD	23	4
Asthma	21	9
Previous vascular procedure	94	39

tation of height or weight. No documentation was available for review regarding modification in weight, dietary advice or recommendations regarding healthy eating and lifestyle as measures for weight reduction. Eighty-four patients were current smokers, 79 were ex-smokers and 73 patients denied any history of smoking. Eight patients did not detail a smoking history. Smoking history was documented on a dedicated smoking cessation and advice form, which prompted the admitting member of staff to initiate and educate patients on measures to help stop smoking.

Medications

Antithrombotics

One hundred and fifty-nine patients were prescribed aspirin and 34 were on clopidogrel prior to their admission to the vascular unit. Sixteen of these patients were on dual therapy. Twenty-five patients were on warfarin with one patient concurrently on aspirin therapy. This equated to 201 (82.3%) patients prescribed antiplatelet or antithrombotic therapy upon admission to the vascular ward. Of the remaining 43 patients, 21 were commenced on aspirin, 2 on clopidogrel, 1 patient on warfarin and 1 was commenced on therapeutic clexane within 24 h of their admission to the vascular unit. One patient had their aspirin increased in dosage from 75 to 300 mg, one patient had aspirin added to previously prescribed clopidogrel for dual therapy, one was commenced on dual therapy having had their warfarin discontinued and one was patient commenced warfarin in addition to previously prescribed aspirin. A further three patients were commenced on aspirin and two were commenced on warfarin within 24 h prior to discharge from the unit. One patient was commenced on aspirin as well as previously prescribed clopidogrel and one patient had their aspirin dose decreased prior to discharge. Eight patients were commenced on clopidogrel in addition to their previously prescribed aspirin and 10 patients were commenced on warfarin with discontinuation of previously prescribed antiplatelet therapy.

This equated to 231 (94.6%) patients prescribed antithrombotic therapy prior to discharge (Figure 2). Of the 13 patients not on antiplatelet therapy, five patients were at extremes of age (15, 25, 90, 94 and 95 years). The authors were unable to identify any contraindications for antiplatelet therapy for the remaining eight patients.

Lipid-lowering medications

One hundred and eighty (73.7%) patients were on lipid-lowering therapy upon admission with 178 patients prescribed a statin. Twenty five of the remaining 64 patients were commenced on a statin within 24 h of admission and a further eight patients were commenced on a statin within 24 h prior to discharge. A total of 213 (87.2%) patients were prescribed statin therapy upon discharge from the unit (Figure 2). The commonest statin therapies used were simvastatin in 79 (32.3%) and atorvastatin in 59 (24.1%).

Antihypertensives

Of the 168 patients who were admitted to the ward with a history of hypertension, 131 patients (78.0%) were on antihypertensive medications.

Eighty-seven (35.6%) patients were on a beta-blocker of which 42 were also on an ACE inhibitor and 9 were prescribed an angiotensin-2 receptor blocker. Seventy five of these patients had a documented history of hypertension and 68 had a history of cardiac disease including myocardial infarction, atrial fibrillation, congestive cardiac disease or angina. Two patients were prescribed beta-blockers within 24 h of admission and four patients had been commenced on beta-blockers within 24 h prior to discharge. A total of 93 (38.1%) patients were receiving beta-blockers on discharge from our unit. Forty-five patients noted to have a history of cardiac disease were not on beta blockade therapy on admission to the unit. The six patients who were commenced on beta blockade as inpatients were in this group.

Eighty-two (33.6%) patients were on an ACE inhibitor on admission to the unit. Seventy-four of

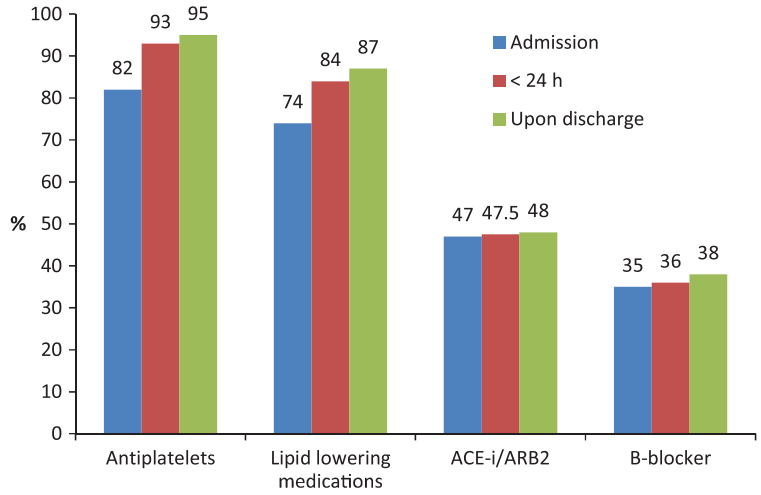

Figure 2 Medication demographics with percentage of patients prescribed antiplatelet, lipid-lowering, angiotensin-converting enzyme inhibitors (ACE-i), angiotensin-2 receptor blockers (ARB2) and beta-blocker (B-blocker) therapies on admission, within 24 h of admission and within 24 h prior to discharge (n = 244)

these 82 patients had a documented history of hypertension and 15 had a history of chronic kidney disease. Forty-two of these patients were prescribed beta-blocker medications with one also requiring an additional angiotensin-2 receptor blocker. A further 33 (13.5%) patients were on an angiotensin-2 receptor blocker, 9 of which were on a beta-blocker and 1 on an ACE inhibitor. Thirty of the 33 patients had a documented history of hypertension and six had a history of chronic kidney disease. One patient was commenced on an angiotensin-2 receptor blocker within 24 h of admission. One patient was commenced on an ACE inhibitor and one on an angiotensin-2 receptor blocker within 24 h prior to discharge. A total of 115 (47.1%) patients were prescribed an ACE inhibitor or angiotensin-2 receptor blocker medication on admission, which was improved to 118 (48.3%) upon discharge (Figure 2).

Glycaemic control

Of the 83 patients with diabetes, 50% had a documented date of diagnosis. Twelve patients managed their diabetes with dietary measures, 45 used oral hypoglycaemics and 38 used insulin. Twelve patients used both oral hypoglycaemics and insulin. Thirty-three patients had a documented pre-operative HbA1c. Six had a reading < 7% and all others had readings > 7%. Six patients were converted to subcutaneous insulin peri-operatively, 9 patients were converted to a sliding scale of subcutaneous insulin, 29 patients had an intravenous infusion of insulin and 49 had no change to their hypoglycaemic regimen. All patients were returned to their pre-operative antidiabetic regimes prior to discharge.

Discussion

Cardiovascular disease is a dynamic disease with fluctuations in prevalence depending on age, gender, ethnicity, socio-economic background and country. The most recently assessed national cardiovascular disease profiles in the UK were published in the 2012 Coronary Heart Disease Statistics dataset (28). In 2010, 31% of males and 29% of females of all ages in England had hypertension. We found the prevalence of hypertension in our cohort of patients, with a median age of 71 years, to be over double that at 69%. However, when we compared our hypertension prevalence with a matched age cohort from the 2012 Coronary Heart Disease Statistics database, our prevalence rate of 69% was closely related to their 65–74 year cohort rates of 65% for males and 63% for females. Further examination of this statistics database revealed that in 2008, hypercholesterolaemia was prevalent in 58% of males and 61% of females of all ages reflecting a similar prevalence of 59% in our cohort. The prevalence from 2006 in males of all ages for myocardial infarction (4.1%), angina (4.8%), stroke (2.4%) and diabetes (6.3%) was significantly lower in the general population than in our cohort of patients where we identified prevalence rates of myocardial infarction 23%, angina 27%, stroke 13% and diabetes 34%. However, it must be stressed that our patient cohort were higher risk vascular patients admitted to a tertiary referral hospital unit for interventions. In England in 2010, 69% of males and 58% of females were found to have BMI's of greater than 25 compared with 45.9% of our patients. We found that 35% of our patients were current smokers and 69% in total had a history of

smoking. This is much higher than the reported incidence of 25% currently smoking in Northern Ireland 2009–2010, but again, it is stressed that our population represents higher risk vascular surgery patients.

Our observation has identified higher prevalence rates of cardiovascular comorbidities in patients admitted to a tertiary vascular unit for a vascular intervention. Patients with aneurysmal disease were twice as likely to have hypertension, six times more likely to have ischaemic heart disease and five times more likely to have had a stroke or diabetes than the general population. They were also more likely to have a current or previous smoking history. In our population, the prevalence of hypercholesterolaemia was comparable to that of general population. In addition, we found that our vascular patients were less likely to be overweight or obese. This higher prevalence of cardiovascular risk factors in vascular patients has also been reported by others. Hirsch et al. reported even higher medical comorbidity rates during risk factor management of community-detected PAD patients compared with our cohort (hypertension 92% vs. 69%; hypercholesterolaemia 86% vs. 59%; angina 53.6% vs. 27%; myocardial infarction 45.1% vs. 23%). Despite these differences, Hirsch et al.'s stroke and smoking rates of 18.8% and 67% were comparable to our study population. However, we stress that these groups were not matched particularly because of the inclusion criteria of Hirsch et al. that included older patients with potentially more baseline comorbidities, while our study included vascular surgery 'all-comers' undergoing surgery (2). Cassar et al. further reported higher prevalence rates of diabetes at 30%, hypercholesterolaemia at 85% and a smoking history in 83% during their assessment of 104 newly diagnosed claudicants compared with the general population (1).

Ferket et al. highlighted significant concerns regarding the gap between the vast amounts of clinical guidelines and the application of this knowledge in clinical practice during their systematic review of cardiovascular risk assessment where only 7 of 1984 publications were deemed of appropriate quality (29). Similar concerns were previously identified by the EUROASPIRE III (2006–2007) survey, which reported that recommendations from previous surveys and guidelines for patients with established coronary heart disease have yet to take effect in twenty-two European countries (30). The EUROASPIRE III survey reported that only lipid management had > 50% of people at goal, while smoking cessation, physical activity, reduction in BMI, waist circumference, blood pressure, total cholesterol, LDL cholesterol and HbA1c measurements in diabetics had all failed to be realised. Indeed, despite the increased use of antihypertensive medications, a normal blood pressure of < 140/90 mmHg was only achieved in 50% of patients (31).

The AHA, ESVS and SIGN guidelines have recommended antiplatelet, lipid-lowering and antihypertensive therapies in patients with AAA and PAD. Optimisation of cardiovascular risk profiles with aggressive behavioural and best medical therapy would afford an opportunity to maximise patient outcomes particularly in those undergoing inpatient interventions. On admission to our unit, 82.3% of patients were prescribed antiplatelet or antithrombotic therapy, 73.7% were on lipid-lowering medications, 47.1% were on ACE inhibitors or angiotensin-2 receptor blockers and 35.6% were on a beta-blocker. This highlights a significant improvement from previous reports by Hirsch and Cassar in 2001 and 2003 who identified compliance rates of between 51% and 72% for antiplatelet or antithrombotic and 34–43% for lipid-lowering therapies (1,2). This improvement is supported by evidence from both the PREPARED study and Daskalopoulou et al. who reported prescribing rates of 70.1% and 82.9% for antiplatelet and 44.4% and 53.6% for lipid-lowering therapies, respectively, at referral to tertiary care (3,6). Hypertensive treatment compliance rates between these early reports and our most recent study were similar (84% vs. 78%). However, we identified that manipulation of the renin–angiotensin system was only performed in 47.1% of patients on admission. With increasing evidence that ACE inhibitors and angiotensin-2 receptor blockers may improve outcomes in patients with atherosclerosis, perhaps targeted treatment with these agents should be considered in all our vascular patients in both primary and secondary care environments. Our study also identified that 18.4% of patients with a history of cardiac disease (myocardial infarction, congestive cardiac failure, angina, atrial fibrillation) were not prescribed beta blockade therapy, which would be suggested as appropriate therapeutic agents from the AHA guidelines for the management of cardiovascular risk factors in patients with a history of cardiac disease (11). This underutilisation of potentially beneficial therapies has been reflected in the PREPARED study, which reported that 32.4% of patients were prescribed ACE inhibitors or angiotensin-2 receptor blockers and only 17.8% prescribed beta-blockers. The increase in prescription of these medications over their 2-year follow-up period was 9.2% and 3.7%, respectively.

Intensive insulin therapy, strict glucose control and adherence to hospital trust protocols have all been shown to improve outcomes in diabetic patients (32–34). Hyperglycaemia has been shown to affect hydration, electrolytes, wound healing, infection rates and incidence of diabetic ketoacidosis in type I dia-

betics (35). All diabetic patients were easily identified within our cohort. However, duration of diagnosis was poorly documented. Antidiabetic regimens for each patient were clearly documented and prescribed on patient medication records. High HbA1c levels have been associated with a reduced long-term survival after coronary artery bypass grafting (36). Although HbA1c laboratory results were readily available, none were found to be documented on the patient admission notes. Also, we noted that no patients were categorised as high risk, based on these blood tests, nor did they receive any additional specialist input regarding their peri-operative glycaemic control. Peri-operative glycaemic control varied according to the patient, operation performed and pre-operative antihyperglycaemic regime. Although the Alberti regimen is the peri-operative glycaemic control favoured by the majority of our vascular anaesthetists, no trustwide standardised peri-operative management guidelines existed during the study time period for the management of these patients. This may reflect the vast number of confounding variables that exist when managing diabetic patients who may present to any speciality within the trust and therefore require an individualised approach informed by the responsible clinicians for each specific episode.

The authors acknowledge significant improvements in the community prescribing of antithrombotic or antiplatelet therapy in Northern Ireland, which is now greater than 74%. The increase in prescribing of antithrombotic and lipid-lowering therapies to 95% and 87% upon discharge confirms our proactive approach to optimising best medical treatment in this patient cohort. Unfortunately, therapeutic adjustment in this patient population can be challenging where the onset of side effects or other medication-related complications can be difficult to address in the community environment. Therefore, the authors believe that inpatient admission for moderate or major vascular intervention presents an ideal opportunity to improve best medical therapy compliance. It is also suggested that commencement of appropriate therapy during the vascular surgery admission is vital, particularly if the hospital admission represented the patient's first presentation of atherosclerotic disease. Future clinical planning should consider pre-operative outpatient clinic reviews by the vascular surgery team combined with anaesthetic assessments as potential target zones to optimise pharmacological compliance prior to admission for the surgical procedure.

Although our experience concurs with results from EUROASPIRE III survey regarding the implementation of treatment for hypercholesterolaemia, identification of patients who may benefit from antihypertensive medication with ACE inhibitors, angiotensin-2 receptor blockers and beta blockade agents remains suboptimal. Our data identified that modification in antihypertensive medications occurred in only 1% of patients, while 3% had beta blockade therapy commenced for cardiac protection in major vascular interventions. Unfortunately, we identified 37 patients with a history of hypertension who were not on ACE inhibitors, angiotensin-2 receptor blockers or beta blockade and a further 45 patients with a history of cardiac disease without beta blockade therapy. This creates a potential missed opportunity to maximise the medical therapy in these patients. Vascular surgeons should therefore remain vigilant to identify and amend these medications appropriately. As the maximum benefit to be gained from these medications is likely to be on a long-term basis, institution of these medications need not occur during acute admission, and strong lines of communication between primary care physicians and vascular surgeons may improve the cardiovascular risk profiles for these patients.

One of the main limitations of this study was the failure to capture all consecutive surgery patients for the index operations. Unfortunately, our hospital does not utilise an electronic medical record and manual retrieval of patient records by our medical record department resulted in a delay between the initial study assessment period and eventual completion of chart review. Despite multiple interval attempts at chart retrieval, we were also unable to source all relevant charts as a result of ongoing clinical care by other medical departments both within and outside our hospital. Although the initial goal of our study was to include all consecutive surgical patients during a 1-year period, the authors believe that the 56.8% patient sample remains representative of our vascular surgery population in Northern Ireland. Although our hospital vascular team currently receives six monthly educational sessions on hypertensive treatment, the authors postulate that perhaps a lack of familiarity with hypertensive pharmacological treatment among surgeons may have reduced antihypertensive pharmacological modification among this patient cohort. In our unit, we maintain a close working relationship with our cardiovascular colleagues for the optimisation of hypertensive therapies in these higher risk patients particularly if clinical follow up is warranted. We now have a dedicated ward-based pharmacist for further advice. We also acknowledge the retrospective nature of the study, which did include follow-up blood pressures or lipid assessment and feel that a subsequent prospective review of our current practice may not only improve capture rate but also afford an opportunity to further improve therapeutic

compliance particularly with hypertensive therapies and monitor target goals for these cardiovascular indices. An assessment of post-operative documentation to the patient's general practitioner may also be targeted in future studies.

Conclusion

Vascular patients admitted to a tertiary referral centre are much more likely to have significant cardiovascular disease. While initiation of antithrombotic and lipid-lowering medications in the community is improving with compliance rates greater than 73%, hospital admission for vascular surgery presents an opportunity to maximise best medical therapy compliance rates. However, we have still not reached 100% compliance for antiplatelet and lipid-lowering therapies, while hypertensive management still remains suboptimal. We emphasise the need for close liaison with hospital physicians and community medical practitioners to further improve and also maintain patient compliance on discharge from the vascular surgery unit.

Funding

None.

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Paper received September 2013, accepted February 2014