Diagnoses and clinical features associated with high risk for unplanned readmission in vascular surgery. A cohort study

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HIGHLIGHTS

- Lower limb ischaemia and diabetic foot sepsis are the two diagnoses with the highest readmission rate.
- Vascular patients are more frequently readmitted for medical rather than surgical health problems.
- For vascular patients, the most common medical, readmission diagnoses are infection renal disease complications and COPD exacerbation.
- Most of the patients readmitted under vascular surgery necessitate further surgical treatment.
- Diabetes may be an independent risk factor for readmission.

ARTICLE INFO

ABSTRACT

Background: Readmission rate is an established health quality indicator. Preventable readmissions bear an unnecessary, high cost on the healthcare system. An analysis performed by the National Centre for Health Outcomes Development (NCHOD) has demonstrated an increasing trend in emergency readmissions in the UK. Vascular surgery has been reported to have high readmission rates second only to congestive heart failure. This study aims to identify diagnoses and other clinical risk factors for high unplanned readmission rates. This may be the first step to sparing both the health care system and patients of unnecessary readmissions.

Results: The overall 30 day readmission rate for Leeds Vascular Institute was 8.8%. The two diagnoses with the highest readmission rates were lower limb ischaemia and diabetic foot sepsis. The readmission rate for medical reasons was overwhelmingly higher than for surgical reasons (6.5% and 2.3% respectively). The most common medical diagnoses were renal disease and COPD. The majority of the patients readmitted under the care of vascular surgery required further surgical treatment.

Conclusion: Vascular units should focus on holistic and multidisciplinary treatment of lower limb ischaemia and diabetic foot sepsis, in order to prevent readmissions. Furthermore, the early involvement and input of physicians in the treatment of vascular patients with renal disease and COPD may be appropriate.

1. Introduction

The 30 day re-admission rate is increasingly being used as a quality indicator of health care delivery [1,2]. Preventable re-admissions bear an unnecessary, high cost on the healthcare system [3,4]. In the United States (US), hospitals are being penalised for high re-admission rates [5]. This has sparked interest in assessing individual institution and regional data in attempt to identify and tackle risk factors for unplanned re-admissions. Despite the fact that similar policies are being considered for the United Kingdom (UK), there are a limited number of studies assessing the clinical risk factors for unplanned re-admission.

Vascular surgery has been reported to have high re-admission rates, second only to congestive heart failure [3]. In the UK, an analysis performed by the National Centre for Health Outcomes Development (NCHOD) has demonstrated an increasing trend in emergency re-admissions [2]. The Department of Health through the, "Emergency Re-admissions, Further Analysis Report", suggests further assessment of a possible link between original admission,

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diagnosis and procedure undertaken, with the emergency re-admission [2]. According to this recommendation, this study aims to identify possible clinical risk factors associated with 30 day un-planned re-admissions rate in Leeds Vascular Institute, one of the largest vascular surgery units in the UK.

2. Material and methods

This study is a one year (April 2011–March 2012) retrospective review of the speciality specific, vascular surgery departmental database and the Hospital Episode Statistics (HES) 30 day re-admission data.

2.1. Databases

The term "speciality specific database" refers to prospective databases updated by a clinical department, usually including in-formation such as admissions and procedures performed. The vascular unit's database is prospectively updated by the doctors in the unit. It is password protected and therefore accessible only to doctors currently working within the unit. Database input is reviewed during a departmental meeting weekly with the mandatory participation of all doctors within the unit, ensuring its accuracy. Speciality specific databases can assess, in a fairly accu-rate manner, the workload of a unit and do not require a major commitment of resources. These databases used for audit and research purposes, but are increasingly used to determine quality of care [6].

Hospital Episode Statistics (HES) are collected by the National Health Service and are used to determine outcomes, which are placed in the public domain. Besides details of in-patient care, HES reports contains outpatient appointments and accident and emergency attendances. The Clinical coding department uses OPCS v4.7 and runs the codes through a 'grouping' programme to generate HRG's (Health Related Groups). The data used for this study was provided by the Leeds Teaching Hospital Episode Sta-tistics Unit. HES data is published on a monthly and annually bases [7].

Anonymised data extracted from the Vascular surgery unit database was used to assess re-admissions under the care of vascular surgery. Equally, anonymised data extracted from the HES database was used to assess re-admissions under specialities other than vascular surgery. The data from both sources was reviewed by two independent assessors, a surgical trainee and a consultant within the unit.

2.2. Patients

The records of 1412 patients admitted under the care of vascular surgery were assessed. Patients who had planned re-admissions, underwent day surgery, attended the accident and emergency department without being re-admitted and were not at risk of re-admission due to death during the initial admission, were excluded from further analysis. Planned re-admissions were defined as re-admissions planned at the time of discharge during the initial admission.

2.3. Outcomes

The primary outcome was the overall 30 day re-admission rate for all vascular surgery patients. The secondary outcomes were admission and re-admission diagnoses as well as co-morbidities which could potentially act as risk factors.

3. Results

3.1. Re-admissions under vascular surgery

Between April 1st 2011 and March 31st 2012, 1412 live dis-charges were reviewed. 537 of the live discharges referred to day case procedures and were excluded from the analysis, in keeping with the NCHOD methodology. Out of the 875 live discharges remaining, 603 were for urgent or emergency admissions and 272 were elective. Age, sex, diagnosis at primary admission, diagnosis at re-admission and 30 day re-admission rates were recorded.

The primary admission diagnoses of those patients admitted to the vascular surgery unit and requiring re-admission within 30 days after discharge are shown in Table 1. The re-admission rate, under the care of vascular surgery, was 2.28% (20 patients, M:F 16:4). Patients with fasciotomy wound problems and amputation stump problems had the highest 30 day re-admission rates although the numbers in these groups were small (2/12, (16.7%) and 2/13, (15.4%) respectively). The two diagnoses with the highest numbers of re-admitted patients are those with Diabetic Foot Sepsis (DFS) 7/65 (10.8%) and lower limb ischaemia 5/52 (9.6%). Out of the 20 patients readmitted under vascular surgery 16 underwent further surgery and 4 had conservative treatment.

3.2. Re-admissions under the care of specialitiesspecialities other than vascular surgery

According to the Hospital Episode Statistics Department, a further 121 patients were recorded as 30 day re-admission under other specialities for the same time period as above. On analysis, 23 of these episodes were referring to attendances to the Accident and Emergency Department. These patients were consequently dis-charged without admission. From the 98 patients remaining, 41 were planned day surgery cases under different specialities un-connected with their vascular admission and were therefore excluded from this analysis, leaving 57 additional patients with true 30-day re-admission possibly associated with the index admission. Initial admission and re-admission diagnoses for re-admissions under the care of specialities other than vascular surgery are shown in Tables 2 and 3 respectively. The most common reasons for re-admission were infection (e.g cellulitis, pneumonia) as well as exacerbation of pre-existing co-morbidities such as Chronic Obstructive Pulmonary Disease (COPD) and renal disease.

3.3. Overall re-admissions

The diagnoses and 30 day emergency re-admission rates under the care of all specialities including Vascular Surgery are shown in Table 4. The overall re-admission rate for all vascular patients was 8.8%. The two diagnoses with the highest number of patients re-admitted, were lower limb ischaemia and DFS. 16 of the patients under the care of vascular surgery required surgery during the

Table 1
Diagnoses of initial admission and 30 day readmission rates, for patients readmitted under Vascular Surgery.

Diagnosis	Number of 30-day readmissions	
Fasciotomy wound problems	2 (12)	16.7%
Critical limb (lower) ischaemia	5 (52)	9.6%
Endovascular aneurysm repair (EVAR)	2 (43)	4.7%
Diabetic foot sepsis (DFS)	7 (65)	10.8%
Amputation stump problems	2 (13)	15.4%
Pseudoaneurysm repair	2 (28)	7.1%
Total emergency 30 day readmissions	20 (875)	2.3%

Table 2
Initial diagnoses for patients readmitted under the care of specialities other than Vascular Surgery.

Diagnosis on original admission	Number of patients readmitted
Carotid endarterectomy	3
Diabetic foot sepsis	11
Critical limb ischaemia/lower limb ischaemia	34
Endovascular repair of aortic aneurysm	2
Subclavian steal syndrome	2
Aortic dissection	2
Other	3
Total	57 (875—6.5%)

Table 3
Reasons for readmission under the care of specialities other than Vascular Surgery.

Readmission diagnosis	Number of readmissions
Renal disease (hypertensive renal disease, end stage renal failure, acute renal failure)	7
Asthma/COPD exacerbation	7
IHD/MI	5
Infection (e.g. Cellulitis, pneumonia)	8
GI tract pathology (Nausea, gastroenteritis, non ischaemic colitis etc)	5
Syncope/collapse	4
Diabetic control	3
Haematological disorder	2
Rheumatological/muscleloskeletal issues	2
Urinary retention	2
Ischaemic bowel	2
Other	10

subsequent admission. 15 of them had surgery both during the admission and readmission. Out of these 8 had the subsequent surgery due to surgical complications and 7 most likely due to progression of disease (e.g diabetes, atherosclerosis) (Table 5).

3.4. Discussion

This study represents one of the few investigations of original admission indications and risk factors for re-admission in vascular surgery in the UK. It has a considerable sample size and has been conducted in one of the largest tertiary vascular surgical units centre in the UK, using NCHOD descriptors. It facilitates the identification of "focus areas" for possible improvement of quality of care.

Several studies have demonstrated discrepancies between clinical and administrative data [28—34]. During the data collection for this study some valuable conclusions were reached about in hospital data collection. "Speciality-specific" databases were found to be more detailed about the initial clinical diagnosis and the progression of the patient, compared to HES data. That however is to be expected as "speciality-specific" databases are populated in a free text manner usually from middle grade and senior trainees. Conversely, HES data is inputted with the use of a drop down menu,

Table 4
Primary diagnoses and readmissions under the care of all specialities.

Primary admission diagnosis	Number of readmission
Lower limb ischaemia	39
Diabetic foot sepsis	18
Endovascular repair of aortic aneurysm	4
Carotid endarterectomy	3
Other	13
Total	77 (8.8%)

usually by junior trainees, but checked by experienced clinical coders.

The obvious disadvantage of "speciality-specific" databases when used for calculating readmission rates, is their de facto failure to include re-admissions under other specialities. On the other hand, being populated in a free text manner by speciality trainees, potentially makes such databases more reliable in associating the initial diagnosis with the re-admission. This is crucial for producing valuable conclusions about the risk factors for re-admission under a specialty and where the team can focus on reducing them.

The HES database is invaluable in getting a global view of re-admissions which is lost by using the specialty specific database on its own. Nonetheless, for the present study, using a combination of the two databases was invaluable as we wished to encompass re-admissions both under vascular surgery and other specialities.

However, it is safe to say that HES data may overestimate re-admissions as it includes day case surgery "re-admissions" and Accident and Emergency attendances. Furthermore, if the clinical database is specialty specific, it will underestimate the readmission rate as it will not include readmissions under other specialties. Also, both databases can underestimate the readmission rate as they fail to record readmissions in other centres and may include planned readmissions. These shortcomings of in hospital data collection used for this study reflect the shortcomings of the study (i.e. the possibility of over or under-estimation of the 30 day readmission rate and inability to definitively associate admission to readmission).

3.5. Overall re-admission rate

The overall 30 day re-admission rate for vascular surgery in our unit (8.8%) is consistent with the general surgery re-admission rates as were reported in the National Centre for Health Outcomes Development (NCHOD) analysis. The main measured outcome was emergency re-admissions 28 days after discharge. "Day case" admissions were excluded from further analysis in NCHOD, and therefore were also omitted in our study. Males were found to have a higher chance of re-admission compared to women, again something confirmed in our study. The re-admission rate in our unit is also consistent with the average, general surgery re-admission rate [8] but is slightly higher than those reported by Commission for Health improvement (5—7%) for the whole of the National Health Service (NHS) [9]. Nevertheless, the comparison with these two figures may not be as accurate as the contribution of vascular surgery to general surgery or all hospital specialties figures is not known. Data collection and evaluation is expected to improve as vascular surgery is now distinct from general surgery in the UK.

3.6. The specialty specific "areas of focus"

The trend towards aggressive limb salvage in patients with advanced peripheral vascular disease and in patients with diabetic foot sepsis has resulted in increased numbers of interventional radiological procedures and in minor amputations and debridement of diabetic feet in an attempt to save limbs.

Lower limb ischaemia and diabetic foot sepsis appear to be the two diagnoses with the highest number of re-admitted patients. Re-admission after lower limb ischaemia is common. Jackson et al. assessed re-admission rates of the vascular surgery department at the University Hospital of Pennsylvania. 799 live discharges over a period of 12 months were assessed. The highest re-admission rates recorded by Jackson et al. were for patients admitted with critical limb ischaemia (14.9%), and patients undergoing open lower extremity revascularization (14.6%) [10]. Goshima et al. [11] report high re-intervention, re-admission rates and prolonged healing in

Table 5
Indication of surgery at index and readmission for patients who had surgery on both occasions.

Associated with index admission surgery		Associated with progression of underlying disease	
Index admission procedure	Readmission procedure	Index admission procedure	Readmission procedure
Rest pain. Common femoral endarterectomy with synthetic patch	Evacuation haematoma, removal of dacron patch (no macroscopic infection), large saphenous vein (LSV) patch and sartorius flap to cover	Intermittent claudication. Common femoral endarterectomy vein patch	Persistent rest pain. Femoral popliteal above knee (AK) vein bypass
At risk graft. Two sites of stenosis: proximal graft vein patch angioplastied. Angioplasty of distal anastomosis failed (on table angio) – jump graft (arm vein) from distal graft to proximal anterior tibial artery (ATA).	Below knee amputation (BKA)	Diabetic foot sepsis (DFS) – great toe amputation	Diabetic foot sepsis – transmetatarsal amputation
Fasciotomy wound debridement (Femoro-femoral cross over graft)	Necrotic infected medial fasciotomy wound. Further debridement and application of VAC	DFS ray amputation and soft tissue debridement	Critical limb ischaemia – angioplasty and stent failed, followed by bypass
Below knee amputation stump debridement	Revision of amputation stump	DFS – ray amputation – soft tissue debridement (second procedure – same admission)	Below knee amputation (BKA)
Below knee amputation stump wound problems, admission for change of VAC	Debridement of amputation stump	DFS – ray amputation	DFS-BKA
Bilateral iliac embolectomy, femoral artery pseudoaneurysm (ruptured) – repaired	Wound infection necessitating debridement	DFS – ray amputation	DFS-BKA
Endovascular repair of aortic aneurysm	Bilateral groin debridement (infected groin wounds post EVAR) with VAC pac application. Sartorius flap to the left	DFS – ray amputation	DFS-BKA
Femoral pseudoaneurysm repair	Skin edges debrided, wound washed		
Total	8	Total	7

patients undergoing infrainguinal bypass surgery. McPhee et al. reported lower limb bypass for critical limb ischaemia 30 day re-admission rate to be as high as 23% [12]. Similar results were reported by Vogel et al. for tibio-peroneal angioplasty 30 day re-admissions (23.8%). 30 day amputation rates were as high as 30% [13].

Diabetes Mellitus has a high prevalence in vascular surgery patients and poses a complexity due to the multiple underlying pathophysiologies through which it can trigger a surgical admission (neuropathic ulcers, sepsis, atherosclerosis and ischaemia) [10,14]. Diabetes has previously been identified as a risk factor both for re-intervention and re-admission which may be associated with poor wound healing and wound infections [10,15–17]. This could possibly explain the high re-admission rates due to wound healing problems in patients who underwent fasciotomy and limb amputation reported in our study. The rate of patients with Diabetic foot sepsis requiring an amputation varies globally from 28.5% to 14% [18–22], with western country having lower rates. Multi-disciplinary approach to diabetes management may help improve those numbers [23–27], however the development of both preventive and therapeutic strategies may be appropriate in order to tackle diabetes related issues more effectively.

Anecdotal reports from surgical colleagues during a departmental presentation of our findings, suggest that DFS patients' reluctance for aggressive treatment, at the initial admission may have led to a subsequent re-admission. Our data confirms this impression, showing that the majority of DFS had a less radical procedure initially, followed by a definitive procedure on re-admission.

Increased focus on predictive factors to improve patient selection to ensure a good outcome from these procedures would be beneficial in reducing the 30 day re-admission rate for patients with these conditions.

3.7. The general medical "areas of focus"

According to the NCHOD analysis, patients admitted for medical issues are more likely to be re-admitted as an emergency (12%) compared to surgical admissions (7%) [2]. This has been demonstrated here as the re-admission rate of patients with a non-surgical diagnosis was considerably higher to the one of patients admitted under the care of vascular surgery with a "surgical" indication (6.5% and 2.3% respectively). Patients with underlying renal disease or COPD should be well supported in the community and appropriately advised at the time of discharge.

As mentioned previously, vascular surgery re-admission rates are only second to those of congestive heart failure. Valuable lessons can be taught from the interventions applied by the American College of Cardiology and the Institute for Healthcare Improvement. The programme "Hospital to Home" was launched in 2009 aiming to reduce all cause 30 day re-admission rates for patients discharged with heart failure and acute myocardial infarction. The programme is based on three pillars: (i) Early follow-up, (ii) Post discharge medication management and (iii) Patient recognition of signs and symptoms. Through this programme patients are guaranteed to have a follow up appointment 1 week post discharge. It is ensured in advance that patients can physically make the appointment (e.g. transport is available). Patients are made familiar and competent with their medication at discharge. It is also ensured that the patients have access to their medication after discharge. Finally, specific instructions are given to patients so as to recognise warning signs promptly and seek appropriate medical advice [35].

Two out of the three "Hospital to Home" pillars can be applied in vascular surgery without imposing any additional cost to the unit. Doctors can be informed of the implementation of patient

education during the departmental induction which always takes place prior to the commencement of their clinical placement.

The "Hospital to Home" scheme relies heavily on identifying patients in high risk of re-admission, prior to discharge [35]. However, in order to accomplish the same in vascular surgery; risk factors for re-admission must be identified. The current study is a step in that direction.

3.8. Conclusion

The 30-day admission rate is a complex metric and in its crude form, has limitations in its use as an indicator of quality of care. It should not be used to penalise healthcare providers unless it is risk adjusted for specific patient groups and specialty specific medical conditions. Crude HES data probably overestimates readmission rates for index admissions and specialty specific databases certainly underestimate readmission rates.

In vascular surgery, peripheral arterial occlusive disease and diabetic foot sepsis are indices of high risk for 30 day readmission under vascular surgery and chronic kidney disease and chronic obstructive pulmonary disease are indices of high risk for 30 day readmission requiring medical treatment. Knowledge of this may help to focus care and resources to reduce readmission.

Conflict of interest

None.

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Author contribution

Marina Yiasemidou: Study design, data collection, data analysis, writing up.

Andrew Mavor: Study design and data collection assistance.

Patrick Kent: Study design, data analysis supervision and writing up.

Guarantor

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