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.

**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.

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1. Introduction

The 30 day re-admission rate is increasingly being used as a quality indicator of health care delivery [1,2]. Preventable readmissions 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,
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 unplanned 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 specialty 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 information 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 accurate 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 Statistics 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 specialties 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 discharges 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 specialties other than vascular surgery

According to the Hospital Episode Statistics Department, a further 121 patients were recorded as 30 day re-admission under other specialties 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 discharged without admission. From the 98 patients remaining, 41 were planned day surgery cases under different specialities unconnected 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 specialties 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 specialties 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 readmitted, 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)                        |
| Critical limb (lower) ischaemia                                           | 5 (52)                        |
| Endovascular aneurysm repair (EVAR)                                       | 2 (43)                        |
| Diabetic foot sepsis (DFS)                                                | 7 (65)                        |
| Amputation stump problems                                                 | 2 (13)                        |
| Pseudoaneurysm repair                                                     | 2 (28)                        |
| Total emergency 30 day readmissions                                      | 20 (875)                      |

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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 the initial diagnosis and the progression of the patient, compared to HES data. However it 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, 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 specialties. On the other hand, being populated in a free text manner by specialty 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 readmissions 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 specialties.

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. Males were found to have a higher chance of re-admission compared to women, again something confirmed in our study. Males were found to have a higher chance of re-admission compared to women, again something confirmed in our study. Males were found to have a higher chance of re-admission compared to women, again something confirmed in our study. Males were found to have a higher chance of re-admission compared to women, again something confirmed in our study. 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Table 5

| Associated with progression of underlying disease | Associated with index admission surgery |
|--------------------------------------------------|----------------------------------------|
| Persistent venous return, popliteal vein varices | Intermittent claudication, common femoral |
| Transmetatarsal amputation                        | Persistent rest pain, femoral-popliteal |
| Evacuation hematoma, removal                       | Great toe amputation, diabetic foot sepsis |
| Below knee amputation                              | DFS ray amputation and soft tissue debridement |
| Below knee amputation stump debridement            | Refeed arterial graft vein patch angioplasty |
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| Below knee amputation                              | Refeed arterial graft vein patch angioplasty |

Diabetes Mellitus has a high prevalence in vascular surgery patients and poses a complexity due to the multiple underlying pathophysologies 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. Multidisciplinary 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 re-admission rates for index admissions and specialty specific databases certainly underestimate re-admission rates.

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

Conflict of interest

None.

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Ethical approval

None required.

Author contribution

Marina Yasemidou: 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

None.

Unique identifying number (UIN)

Not applicable.

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