

## Surgeons' Perceptions of the Causes of Preventable Harm in Arterial Surgery: A Mixed-Methods Study

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### WHAT THIS PAPER ADDS

It is well established that patient risk factors and procedural volume/technique relate to patient outcome for a range of arterial procedures. This paper provides a summary of vascular surgeons' reports of broader 'system' factors influencing the safety of patients undergoing arterial surgery. Vascular surgeons perceive that adverse events are not solely related to inherent complexities in the procedure or the patient's condition, but are commonly caused by a combination of team, environment, and organisational failures, which may combine to cause harm.

**Background:** System factors contributing to preventable harm in vascular patients have not been previously reported in detail. The aim of this exploratory mixed-methods study was to describe vascular surgeons' perceptions of factors contributing to adverse events (AEs) in arterial surgery. A secondary aim was to report recommendations to improve patient safety.

**Methods:** Vascular consultants/registrars working in the British National Health Service were questioned about the causes of preventable AEs through survey and semi-structured interview (response rates 77% and 83%, respectively). Survey respondents considered a recent AE, indicating on a 5 point Likert scale the extent to which various factors from a validated framework contributed toward the incident. Semi-structured interviews were conducted to obtain detailed accounts of contributory factors, and to elicit recommendations to improve safety.

**Results:** Seventy-seven surgeons completed the survey on 77 separate AEs occurring during open surgery ( $n = 41$ ) and in endovascular procedures ( $n = 36$ ). Ten interviewees described 15 AEs. The causes of AEs were multifactorial (median number of factors/AE = 5, IQR 3-9, range 0–25). Factors frequently reported by survey respondents were communication failures (36.4%;  $n = 28/77$ ); inadequate staffing levels/skill mix (32.5%;  $n = 25/77$ ); lack of knowledge/skill (37.3%;  $n = 28/75$ ). Themes emerging from interviews were team factors (communication failure, lack of team continuity, lack of clarity over roles/responsibilities); work environment factors (poor staffing levels, equipment problems, distractions); inadequate training/supervision. Knowledge/skill ( $p = .034$ ) and competence ( $p = .018$ ) appeared to be more prominent in causing AEs in open procedures compared with endovascular procedures; organisational structure was more frequently implicated in AEs occurring in endovascular procedures ( $p = .017$ ). To improve safety, interviewees proposed team training programmes (5/10 interviewees); additional protocols/checklists (4/10); improved escalation procedures (3/10).

**Conclusion:** Vascular surgeons believe that AEs in arterial operations are caused by multiple, modifiable system factors. Larger studies are needed to establish the relative importance of these factors and to determine strategies that can effectively address system failures.

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### INTRODUCTION

Some of the highest rates of preventable adverse events are in vascular patients undergoing surgical intervention,<sup>1–5</sup> yet relatively few studies have sought to identify the preventable causes of these incidents in vascular surgery. Operator and institution inexperience, deficiencies in technical skills,

and inappropriate patient selection are known to be associated with poorer outcomes.<sup>6</sup> In a small number of single centre studies, observers have reported failures relating to equipment, workspace configuration, communication, and teamwork.<sup>7,8</sup> These findings have been corroborated in a larger, multicentre observational study of 'system' failures in aortic surgery in the UK.<sup>9</sup> Non-technical failures have been linked to intra-operative errors, procedural problems, and longer operating times, but their direct relationship with patient harm is less clear.<sup>7,8</sup> To ensure the best outcomes, the vascular community must seek to understand the preventable causes of adverse events and target interventions to improve safety across the specialty. Vascular surgeons are ideally placed to comment on factors leading to adverse events, yet to date their views have not been formally reported. The aim of this exploratory, mixed-methods study was to describe vascular surgeons' perceptions of factors contributing towards adverse events in arterial surgery. A secondary aim was to report vascular surgeons' recommendations for improving the safety of these patients.

## METHODS

### *Overview and definitions*

In this exploratory, mixed-methods study, surveys and semi-structured interviews elicited vascular surgeons' perceptions of the causes of adverse events in patients undergoing arterial surgery, and interviewees were asked to provide recommendations for improving the safety of these patients. 'Adverse events' were defined as unintended injuries to patients caused by medical management rather than the patient's underlying condition, leading to prolonged hospital stay, temporary or permanent disability, or death.<sup>10</sup>

### *Inclusion criteria and recruitment of participants*

To obtain a high response rate, a convenience sample of 100 surgeons were approached face to face during three vascular conferences between November 2012 and September 2013 and were invited to complete the survey. Interviewees were either survey respondents or clinical contacts invited to participate based on their geographical work location or level of training to ensure a diverse sample. Surgeons were eligible to participate in the study if they regularly performed open and endovascular arterial operations in the British National Health Service (NHS) and were vascular consultants, vascular registrars, or general surgery registrars with a sub-interest in vascular surgery. Interviews continued until a diverse sample was obtained in terms of interviewee level of training and geographical work location.

## MATERIALS AND METHODS

A validated framework of factors known to contribute to adverse events in health care was used to devise the survey. The framework, which is described in full elsewhere,<sup>11,12</sup>

lists 25 contributory factors organised under the following headings: patient, staff, teams, the work environment, organisation and management, and institutional context. Respondents were asked to consider each contributory factor in relation to an adverse event: (1) that they had personally witnessed and could recall the circumstances of, (2) that had occurred during or within 24 h of an open or endovascular arterial procedure, and (3) that was caused by medical management rather than underlying disease, and resulted in prolonged hospital stay, disability, or death. Respondents scored all factors in relation to the adverse event on a Likert scale; a score of 5 was 'highly likely' to have contributed, a score of 1 was 'highly unlikely' to have contributed, and a score of 3 was neutral. To facilitate comparison between groups (consultants versus registrars; emergency versus elective procedures) in a small sample, survey responses were later converted to binary variables, where factors judged as at least 'somewhat likely' to have contributed to adverse events were coded as 1, and the remainder were coded as 0. Respondents were asked to indicate their level of training (consultant or registrar), the type of procedure that the adverse event related to (open or endovascular surgery), the procedure setting (elective or emergency), and the consequences of the adverse event. To preserve anonymity and to encourage a higher response rate, survey respondents were not asked to give their name or work location. The survey was piloted with eight vascular trainees to ensure acceptability with subsequent minor changes to the syntax of instructions. Survey administration was paper based, and was undertaken by a single researcher (RL: clinical research fellow). The semi-structured interview schedule elicited detailed accounts of perceived factors leading to adverse events, as well as recommendations to improve patient safety in arterial surgery. All interviews were undertaken by a single researcher, recorded, transcribed verbatim by a professional independent transcriber, anonymised, and assigned a study identification number.

### *Analysis*

The most frequently reported contributory factors were calculated from quantitative survey responses. It was hypothesised that the following characteristics could influence perceptions of the profile of factors contributing towards an adverse event: (1) respondent's level of training (consultant versus trainee), (2) procedure type (open versus endovascular) and (3) setting (elective versus emergency). These hypotheses were tested using Pearson's chi-square analysis. The Bonferroni correction was not deemed appropriate because of the exploratory nature of the study.

Analysis of interview transcripts adhered to the principles of the 'framework method', which outlines key steps in the process of thematic analysis<sup>13</sup> to ensure a systematic approach (Box 1). The researcher (RL), who had received formal training in the framework method through an

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