IDENTIFYING PATIENT SAFETY IMPROVEMENT TARGETS FOR SURGICAL SIMULATION: TOWARDS MODELLING AN ERROR-FREE ENDOVASCULAR OPERATING THEATRE

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BACKGROUND

Patient safety has become an important healthcare issue over the last decade with reports of a significant proportion of hospitalised patients experiencing a safety incident. Recent advances in minimally invasive surgical techniques have meant that the operating theatre environment has changed immeasurably. In particular, the development of endovascular techniques in vascular surgery has meant that procedure outcomes are increasingly influenced by technology-related performance and multiple specialty interactions. These rapid advances in technology, combined with the demands for increased patient safety, have led to a growing interest in simulation as a tool for addressing the patient safety challenge.

OBJECTIVES

The aim of our research programme is to investigate avoidable failures in patient safety for patients undergoing vascular and endovascular procedures to guide future quality and safety interventions.

METHODS

A direct observation methodology was employed to identify intraoperative failures over a 9-month period at a tertiary vascular surgical centre. Event logs were recorded for each procedure. Two blinded experts identified and independently categorised failures into 22 types (using a validated category tool) and severity (5-point scale). Data are expressed as median (range). Statistical analysis was performed using Mann-Whitney U, Kruskal-Wallis and Spearman's Rank tests.

RESULTS

A total of 66 procedures ((17 thoracoabdominal and 23 abdominal aortic aneurysms, 4 carotid and 22 limb procedures) were observed over the study period (251 hours operating time). 1145 failures were identified in total with good inter-assessor reliability (Cronbach's alpha 0.844). The commonest failure types related to equipment (including unavailability, configuration and other failures) (269/1145 [23.5%]) and communication (240/1145 [21.0%]). A comparatively lower number of technical and psychomotor failures were identified (103 [9.0%]). The number of failures correlated with procedure duration (rho = 0.695, $p < 0.001$) but not anatomical site of the procedure or pathology of the disease process. There were 33 combined procedures (involving open vascular and endovascular stages) and 33 open vascular procedures. Failure rate was significantly higher in patients undergoing combined surgical/endovascular procedures compared to open surgery (median 5.7/h [IQR 4.2-8.1] vs 3.0/h [2.5-3.5]; $p < 0.001$). The severity of failures was similar (1.5/5 [1-2] vs 1/5 [1-2] respectively; $p = 0.095$). For combined procedures, failure rates were significantly higher during the endovascular (stenting) phase (9.6/h [7.5-13.7]) compared to the non-endovascular phase (3.0/h [1.0-5.0]; $p < 0.001$).

DISCUSSION & CONCLUSIONS

Failures in patient safety are common during complex arterial procedures. Few failures were severe, although minor failures occurring during critical stages and accumulation of multiple minor failures may potentially be important. Failures occurred especially during the endovascular phase and were often related to equipment or communication aspects, perhaps due to the higher reliance on technology and multidisciplinary team interactions. Interventions to improve procedural safety and quality of care should primarily target these areas.

Using these findings, within the domain of endovascular virtual reality (VR), our research group (European Virtual Reality Endovascular Research Team; EVEResT) is currently exploring the role of patient-specific simulated rehearsal to minimise intraoperative failures by incorporating patient-specific computed tomography and magnetic resonance imaging data into the simulation and subsequent rehearsal of real patient cases to identify and correct potential failures in a low-risk environment. We have utilised this VR simulation technology for the carotid artery stenting procedure with promising results. Successful incorporation of this technology in multiple surgical domains could eventually increase safety and minimise complications for patients undergoing standard and more complex procedures.