**Surgical time out checklist with debriefing and multidisciplinary feedback improves venous thromboembolism prophylaxis in thoracic surgery: a prospective audit**

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**Abstract**

**OBJECTIVES:** There is a significant global burden of preventable morbidity and mortality after surgery caused by avoidable adverse events. Venous thromboembolism (VTE) prophylaxis, despite evidence for its efficacy, is not reliably and consistently prescribed, and is currently a serious concern for patient safety. The aim of this study was to prospectively audit errors captured by an extended surgical time out checklist and relate them to the introduction of a safety culture.

**METHODS:** The use of an extended surgical time out checklist was prospectively audited, in consecutive patients in one operating theatre over a period of two years. Errors captured were analysed and related to other improvements to safety culture; human factors training, debriefing and regular departmental meetings.

**RESULTS:** Time out was performed in 959 patients of 990 (96.8%) undergoing thoracic surgery. Performance was consistent over time. Errors were categorized as VTE prophylaxis (n = 53, 6%), blood products (n = 11), clerical (n = 5), imaging (n = 2) and miscellaneous (n = 2). After a lag period of 15 months, during which the team underwent human factors training, introduced debriefing and escalated VTE prophylaxis to regular departmental meetings, VTE prophylaxis errors were substantially reduced. The temporal relationship between error capture and error elimination is explored.

**CONCLUSIONS:** Use of checklists alongside appropriate human factors training, debriefing and regular multidisciplinary communication can substantially improve VTE prophylaxis in patients undergoing surgery.

**Keywords:** Medical errors • Safety • Operative • Prospective studies • Venous thromboembolism

**INTRODUCTION**

An estimated 234 million surgical procedures are performed globally each year [1]. Around one million patients die and seven million patients develop complications, of which 50% are thought to be preventable [2, 3]. One in every 150 patients admitted to a hospital dies as a consequence of an adverse event, almost two-thirds being associated with surgical care [4]. Venous thromboembolism (VTE) is considered to be the most common preventable cause of hospital-related death [5], surgery being an important risk factor. Despite overwhelming evidence for efficacy of VTE prophylaxis, omission or inappropriate prophylaxis is still a major safety concern [6].

A variety of tools are described which may prevent unnecessary harm during surgery, including training in teamwork, human factors and system change. Checklists are a universally used tool in high-risk organizations to ensure that all crucial steps in complex tasks are completed. As part of a process towards improving team work and communication, checklists may be used to remind the user of a step, or to prevent progress before a critical step is completed.

In 2008, the second WHO Global Patient Safety Challenge – Safer Surgery issued a three-step Safer Surgery Checklist which reported reductions in mortality and morbidity from surgery performed in eight different surgical centres [7]. The checklist comprised three sections: sign in (prior to anaesthesia), time out (prior to incision) and sign out (prior to leaving theatre). Since then, larger, controlled studies have confirmed a significant reduction in surgical mortality with appropriate training and implementation of preoperative briefings, operating theatre checklists and postoperative debriefings [8].

An adapted WHO checklist, the five steps to surgical safety (preoperative briefing, sign in, time out, sign out, postoperative debriefing) was mandated for National Health Service hospitals by April 2010 by the National Patient Safety Authority. Prior to this mandate, our hospital introduced an extended time out checklist to address potential issues of correct site surgery and
VTE prophylaxis. This publication reports the design, implementation and audit of this time out checklist with particular emphasis on VTE prophylaxis.

**MATERIALS AND METHODS**

A ‘time out’ checklist was designed by the authors following good practice guidelines for standard operating procedures [9]. It was a ‘final check’ that appropriate safety criteria were met prior to incision. The time out checklist was distributed throughout surgical, anaesthetic and operating theatre directorates and the authors held multidisciplinary meetings with each group to explain the rationale behind introducing time out and discuss concerns. Users were invited to propose changes to the time out checklist after it had been in use for 3 months. The revised version is shown in Fig. 1.

An A1 laminated version of the time out was read as a script, with the anaesthetized patient stable on the operating table, prior to surgical scrub. The red text was read by the operating surgeon and the blue text by the anaesthetist. The scrub team listened in. There was no paper version of the checklist; documentation merely recorded that the time out was performed.

Any omission found at time out was acted upon appropriately (e.g. antithromboembolic stockings applied, calf pumps applied, heparin prescribed).

The time out was introduced in May 2008 as a compulsory prelude to all operative interventions in the Trust. Its use was made compulsory for all operating theatres by the Medical Director (IW) as a requirement by the Trust Governance Committee and Chief Executive.

As time out was implemented Trust-wide, a continuous prospective audit was undertaken during thoracic surgical operating lists in one theatre by adding two fields to the departmental database. This was the only theatre database in which additional mandatory fields could be easily implemented. The data fields were completed prior to printing the operation note, to record whether time out was performed and to capture any errors. A second version of the time out was introduced in August 2008 clarifying the demonstration of imaging and adding a check for the availability of blood products (Fig. 1).

Data were exported over a 24-month period (May 2008–April 2010); errors captured were classified into five broad categories; VTE prophylaxis, blood, clerical, imaging or miscellaneous and monthly rates computed. VTE prophylaxis errors were analysed by a subcategory (low molecular weight heparin, LMWH, omission, LMWH dose error, antithromboembolic stockings omitted, calf pumps omitted).

During the study period, members of the theatre team (surgical, anaesthetic, nursing and Operating Department Assistant) attended a human factors training day (January 2009) as a result of which, team briefing and de-briefing were introduced to the theatre. Monthly multidisciplinary departmental meetings (surgical, anaesthetic, ward, theatre, recovery, specialist nurse, dietician and physiotherapy) were already being undertaken at which identified problems and improvements in practice were discussed and recorded. Minutes of all meetings held between January 2007 and March 2010 were examined for discussions relating to time out errors or safety improvement and these were related to the analysis.

**RESULTS**

Data on 990 consecutive patients operated on in thoracic surgery over the period May 2008–April 2010 were extracted from the theatre database and analysed.

**Compliance with time out process**

Time out was performed in 959/990 patients (96.8%) and was not performed in 36 patients, of whom 28 underwent either a short endoscopic or local anaesthetic procedure. Fig. 2 shows the monthly compliance with the time out process as a control chart. The process achieved 96% compliance over the period May 2008–April 2010. The dotted line is the lower control limit and the upper limit is not shown because it is above 100%.

**Errors detected at time out**

Seventy-three errors were identified from 959 time outs. No individual patient had more than one error detected. Errors were categorized as VTE prophylaxis (n = 53), blood products (n = 11), clerical (n = 5), imaging (n = 2) and miscellaneous (n = 2).

![Figure 1: The time out checklist used in this study.](image1)

![Figure 2: Compliance with time out over the study period.](image2)
VTE prophylaxis errors were identified in 53/959 (6%) of time outs, occurring sufficiently frequently to permit a trend analysis. Fig. 3 shows the percentage of time outs each month that identified a VTE error in the thoracic surgery lists as a control chart.

Because VTE prophylaxis errors were a relatively rare event, an alternative way of presenting the results using a 'cases between' control chart is shown as Fig. 4 [10, 11]. This control chart plots the number of days between identified VTE prophylaxis errors. Fig. 4 shows that a VTE prophylaxis error was identified on average every 18 cases. During October and November 2008 (cases 224 and 298), there were fewer patients between VTE prophylaxis error cases. At the end of the study period there were three long intervals between identified VTE prophylaxis errors.

Fig. 4 shows that a VTE prophylaxis error was identified on average every 18 cases. During October and November 2008 (cases 224 and 298), there were fewer patients between VTE prophylaxis error cases. At the end of the study period there were three long intervals between identified cases reflecting an improvement in the VTE error rate. The last data point showing 147 cases between errors reflects a minimum VTE error rate. The last error was reported for case number 849 and so we have assumed that the next error will be reported for case 996 (the next in the series) in order to calculate a value. This is an assumption as we do not know when the next error will actually occur.

Classification of VTE error

The 53 VTE prophylaxis errors identified during the 2-year period comprised omission of preoperative LMWH (n = 29), omission of antithromboembolic stockings (n = 16), omission of intermittent calf compression pump (n = 5) and dose error of LMWH (n = 3).

Correlation with multidisciplinary team meetings

There were no references to any issues relating to the subsequently identified time out error categories in the minutes of the 11 meetings held between January 2007 and May 2008. Following the Trust-wide introduction of time out in June 2008 the minutes of 13 of the 22 multidisciplinary team meetings documented discussions, policy statements or comments relating to one or more categories of VTE errors or blood availability issues.

Fig. 5 shows the temporal relationship between minuted multidisciplinary departmental discussions or guidance related specifically to VTE prophylaxis issues of LMWH prescription (A), foot pumps availability and use (B) and application of TED stockings (C).

DISCUSSION

We have described the effect of introducing an extended time out checklist on reducing VTE prophylaxis error, but emphasize that the checklist is only one element, albeit important, of an improved safety culture.

Bosk et al. [12] have warned of the dangers of the 'simple checklist' solution in isolation without incorporating training in teamwork, communication and systems change. 'Safer care is achieved when all three— not just one— of the following are realized: summarize and simplify what to do; measure and provide feedback on outcomes; and improve culture by building expectations of performance standards into work processes'. Clarke et al. [13] point out that wrong site surgery still occurs with formal checklists in place. Extending the use of checklists across the whole of the surgical care pathway, not just in the operating theatre, can reduce surgical complications and mortality [14]. Checklists for VTE prophylaxis early in the patient’s hospital pathway have been shown to improve VTE prophylaxis [15].
In this prospective audit, time out achieved 96% compliance throughout the study period, within which there was some variation (86–100%). There was no change in the overall compliance of the time out process, which is shown to be sustainable. The majority of patients in whom time out was not performed had minor or intermediate procedures; errors are just as likely to occur in these patients (e.g. correct site) so performing time out in all patients needs to be emphasized.

Timeout quickly became part of routine practice from the start of this study. This reflects a combination of favourable circumstances; the choice of a theatre team who believed in the benefits of checklists, management support, simplicity of process, minimization of documentation, proactive explanation to users and appropriate user feedback.

VTE prophylaxis errors were surprisingly uncommon but were by far the most common errors captured; 6% of patients had an error in VTE prophylaxis corrected. The ENDORSE study, a multinational cross-sectional study in the acute hospital setting reported that only 58.5% of 19 842 surgical patients at risk in 358 hospitals across 32 countries received American College of Chest Physicians-recommended VTE prophylaxis [16]. VTE prophylaxis errors reduced over time and occurred less frequently. The last eight data points in Fig. 3 were all below the average period suggesting that there was a sustained reduction in detection VTE prophylaxis errors.

Time out raised the team’s awareness of VTE prophylaxis, demonstrated by the discussions on this topic in the monthly Departmental meetings (Fig. 5). Without debriefing, introduced after human factors training (Fig. 5), many of these errors would not have resulted in changing team policy. This illustrates the potential ‘disconnect’ between errors being prevented on a ‘simple check list’ and a real change in safety culture. This ‘disconnect’ may explain why there was a delay of about 15 months between capturing errors and eliminating them. Having achieved a high standard for VTE prophylaxis, continued audit and feedback to the team will be required to maintain performance.

CONCLUSION

This audit has demonstrated that a time out checklist performed at the time of surgery identifies and corrects errors in VTE prophylaxis in a significant proportion of patients. A time lag was demonstrated between capturing these errors and eliminating them, probably reflecting human factors training adoption of postoperative debriefing and discussion in regular multidisciplinary meetings. VTE prophylaxis errors can be reduced significantly in surgical patients by a combination of appropriate checklists with human factors training, debriefing and regular multidisciplinary feedback meetings.

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References