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Reducing the potential for phlebotomy tourniquets to act as a reservoir for meticillin-resistant *Staphylococcus aureus*

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Summary The contamination rate of phlebotomy tourniquets with meticillin-resistant *Staphylococcus aureus* (MRSA) was assessed, and it was determined whether this could be reduced by changes in practice or by the use of a physical barrier. Initially, the tourniquets of both pre-registration house officers and phlebotomists were investigated, but as phlebotomists reported significantly more venepunctures daily, the trial continued solely with phlebotomists. Each day, the phlebotomists were supplied with a fresh sterile tourniquet, and after use, the tourniquets were swabbed and cultured. The rate of contamination with MRSA was 32 of 131 (25%) tourniquets. An audit of hand hygiene practice was undertaken and revealed that phlebotomists were performing hand decontamination inadequately between patients and wore wristwatches while working. Education comprising standard infection control methods to encourage good practice was given. After this, a polythene strip was used as a barrier by half of the phlebotomists during all venepunctures. Tourniquets were cultured and replaced daily as before. During this stage of the trial, the rates of contamination were 1 of 46 tourniquets (using a polythene strip) and 1 of 42 tourniquets (without using a polythene strip). In conclusion, phlebotomy tourniquets may be potential vectors for transferring bacteria, including MRSA. Contamination rates, and hence potential risk, can be reduced if hand decontamination is

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performed. This suggests that contamination of tourniquets is via phlebotomists' hands, not directly from patients' skin. Hand hygiene should be regarded as the most important method by which the spread of organisms can be reduced.

Introduction

Venepuncture commonly involves the use of a rubber or elasticated cloth tourniquet, applied around the patient's upper arm. The detection of meticillin-resistant *Staphylococcus aureus* (MRSA) on phlebotomy tourniquets has been the subject of several articles,[1–3] and the potential as a vector for cross-infection has been suggested by a recent letter to the *BMJ*.[4] Current phlebotomy guidance is that the tourniquet should be decontaminated between each patient.[5] However, unless disposable tourniquets are being used (at a cost of £0.07 each), this practice is rarely carried out, and indeed the physical nature of the tourniquet (the elasticated fabric tourniquet being a more popular style than the rubber variety) means that a reliable method of decontamination is difficult to achieve. The aim of the present study was to investigate the rate of tourniquet contamination with MRSA and, if a risk was present, to assess whether the risk could be reduced.

Methods

Hospital setting

The study took place in an adult critical care ward, five general medical wards, four care of the elderly wards and six surgical wards of a 633-bed district general hospital. The study lasted almost six months, during which time the number of hospital inpatients with MRSA notified to the infection control service per month was approximately constant (range 43—63 new referrals/month, average 53 new referrals/month).

Microbiology

The tourniquets were collected from the users at the end of a normal working day. The tourniquets were collected into polythene specimen bags, coded and transported to the laboratory. The microbiology analysis was carried out by a single biomedical scientist who was unaware of the trial procedure until the end. In the laboratory, the tourniquets were pressed on to Columbia blood agar (Oxoid Ltd, Basingstoke, UK) and mannitol salt agar (Oxoid Ltd), then swabbed lengthwise by a sterile moist swab. This was then used to inoculate 7% salt broth (Oxoid Ltd). After 24 h of incubation at 37 °C, the broth was inoculated in lines across an isosensitest plate (Oxoid Ltd). A 5-μg meticillin strip (Mast Group Ltd, Bootle, UK) was applied to the centre of the plate, perpendicular to the inocula, and the plate was incubated at 30 °C for a further 24 h. Known meticillin-susceptible and -resistant strains of *S. aureus* were used as controls on each plate. Organisms were confirmed as *S. aureus* by standard methods for the detection of coagulase. On the Columbia blood agar and mannitol salt agar plates, a count was made of colony-forming units (CFUs)/cm^2.

Sampling procedure

As a pilot study, tourniquets from the preregistration house officers ($N = 17$) and phlebotomists ($N = 5$) were collected and sampled. The standard operating procedure at this stage of the study was that tourniquets be replaced when visibly soiled with biological material. The participants were asked how long they had been using the tourniquets.

The phlebotomists alone continued in the study as the preregistration house officers reported performing venepuncture infrequently. The phlebotomists were asked to submit their tourniquet for culture after each day's shift (approximately 50 patients). The tourniquets were sampled as before, and a fresh, sterile tourniquet was re-issued as a replacement.

An audit of the phlebotomists' hand hygiene practice was carried out. The phlebotomists' supervisor (IG) was aware of the audit but was not informed when the audit would take place, and the phlebotomists themselves were unaware that an observational audit was being carried out. An infection control nurse (AL) observed the phlebotomists whilst carrying out their duties for approximately 30 min in ward areas.

A polythene strip applied to the patient's upper arm under the tourniquet was introduced. The polyethene strips were supplied on a revolving drum attached to three of five phlebotomy trolleys. The trolleys with strip dispensers were alternated between the five phlebotomists daily. The supervisor coded the tourniquet accordingly and kept a record of the assignment. The tourniquets were again delivered for culture each day. The biomedical scientist was unaware of the stages of the study or of the use of polythene strips.

Statistical analysis

The MRSA contamination rates between the different phases were compared by Mantel-Haenszel's Chi-squared test and Fisher's exact test using Epi-Info Version 6.

Results

During the pilot phase, the preregistration house officers reported using each tourniquet for one week to 10 months (median two months), and two of their 17 tourniquets (12%) were contaminated with MRSA. Phlebotomists tended to use each tourniquet for 10 days to two months (median one month), and three of five of their tourniquets were found to carry MRSA.

During the second phase of the study, tourniquets from phlebotomists were replaced and analysed on a daily basis. MRSA was isolated from 32 of 131 tourniquets (24.4%), *S. aureus* from 12 (9%) and coagulase-negative staphylococci from 73 (56%). More than one organism was reported from six tourniquets, and the others ($N = 14$) contained unidentified, mixed 'skin flora' (diphtheroids, proprionibacteria, etc.).

In the third phase of the study, phlebotomists were observed whilst obtaining four to six individual blood samples. The main finding from the observational audit was the phlebotomists' failure to follow hand hygiene practices. Although alcohol gel dispensers were present on each phlebotomy trolley, only two out of the five staff were observed to use gel, but even then with incomplete technique. All staff wore wristwatches; gloves were only worn when taking a blood sample from a patient in an isolation room. Handwashing occurred after removal of the gloves. To address these issues, an education programme was initiated. This focused heavily on hand hygiene in a lecture with the use of an ultra-violet glow box, video and handouts. Other areas covered were the use of protective clothing, the safe disposal of sharps, single-use items and risk assessment. Instructions on the appropriate use of alcohol gel, together with removal of jewellery and wristwatches during practice, were given, and a 'safe code of practice for phlebotomists' leaflet, including references to further reading, was issued. After observational practice audit and hand hygiene education, a polythene strip, which is wrapped around the upper arm as a barrier, was introduced and used by half of the phlebotomists during all venepunctures. Tourniquets were cultured and replaced daily as before.

Using the polythene strip, MRSA was isolated from one of 46 tourniquets (2.2%) and coagulase-negative staphylococci were isolated from 37 of 46 tourniquets (80%). In the absence of this barrier method, one of 42 tourniquets was contaminated with MRSA (2.4%) and 34 of 42 (81%) tourniquets were contaminated with coagulase-negative staphylococci. The difference in the MRSA contamination rate in the presence and absence of the polythene strip was not significant ($P = 1$, Fisher's exact test). However, the difference between the MRSA contamination rate before and after hand hygiene education was significant ($P = 0.0016$, Mantel-Haenszel's test).

There was no correlation between the number of CFUs/cm^2 and length of use, pre- and post-hand decontamination, or use of a polythene strip (data not shown).

Discussion

There have been numerous reports of the isolation of MRSA from various items of equipment that come into close, or direct, contact with patients. Establishing the contaminated fomite as the sole vector for cross-infection may be difficult, or impossible, but an attempt to reduce the bioburden in the immediate patient environment is advisable. Methods of decontaminating items of re-usable medical equipment such as stethoscopes and sphygmomanometer cuffs have been published, but the authors were unable to find any practical recommendations regarding phlebotomy tourniquets other than the use of disposable items. The single-use, disposable tourniquets were unpopular with users, due to the nature of achieving pressure and the unsuitability for larger arms. Also, a switch to their universal use would require a considerable financial cost to a healthcare organization (>£30 000/year for NHS Lanarkshire). This project set out to determine

whether disposable polythene strips could be used to prevent contamination of tourniquets by patients (and hence reduce the risk to subsequent patients during venepunture using the same tourniquet). If so, the use of the favoured style of tourniquet could be continued, with a theoretical reduction in the potential risk of cross-infection, and at a greatly reduced financial cost.

Initially, a considerable number of tourniquets were contaminated with MRSA. Even with daily tourniquet replacement, MRSA could be detected on almost 25% (32/131) of the tourniquets sampled. A review of hand hygiene practices, the introduction of alcohol gel and an education programme reduced the contamination rate. Due to the significant reduction in the rate of contaminated tourniquets (2/88; 2.3%), no difference could be seen when using a polythene strip as a barrier. Although the authors do not advocate any relaxation in standards of cleaning personal and medical equipment, this study suggests that an important mechanism by which medical and personal equipment may become contaminated by bacteria is via the user, and not directly from the patient. Breaking the chain of events that can transfer micro-organisms can lead to a lower level of potential pathogens in the immediate patient environment. The use of disposable tourniquets, or a protective polythene strip as a barrier, may be unnecessary if standards of hand hygiene can be achieved and maintained.

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