A study of microbial colonisation of orthopaedic tourniquets

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ABSTRACT

INTRODUCTION Tourniquets are employed widely in orthopaedic surgery. The use of the same tourniquet on a repetitive basis without a standard protocol for cleaning may be a source of cross-infection. This study examines the contamination of the tourniquets in our institution.

MATERIALS AND METHODS Agar plates were used to take samples from 20 tourniquets employed in orthopaedic procedures. Four sites on each tourniquet were cultured and incubated at 37°C for 48 h.

RESULTS All sampled tourniquets were contaminated with colony counts varying from 9 to > 385. Coagulase-negative *Staphylococcus* spp. were the most commonly grown organisms from the tourniquets (96%). Some tourniquets had growths of important pathogens including methicillin-resistant *Staphylococcus aureus* (MRSA), *Pseudomonas* spp., and *S. aureus*. On cleaning five tourniquets with Clinell (detergent and disinfectant) wipes (GAMA Healthcare Ltd, London, UK), there was a 99.2% reduction in contamination of the tourniquets 5 min after cleaning.

CONCLUSIONS In addition to the manufacturers' guidelines, we recommend the cleaning of tourniquets with a disinfectant wipe before every case.

KEYWORDS

Tourniquet – Agar plate – Colony count – Contamination

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Surgical-site infection causes significant reduction in quality of life of patients and places enormous burdens on healthcare systems.^{1,2} In orthopaedic surgical-site infections this translates to a greater than 300% increase in healthcare costs, increased hospital stays, re-admissions and poor patient outcomes.² Pneumatic tourniquets are routinely employed in orthopaedic surgery. Most institutions do not have a standard protocol for cleaning tourniquets.³ Non-sterile tourniquets which are used repetitively on patients without a standard protocol for their cleaning may be a source of infection.

Contamination of medical equipment including phlebotomy tourniquets,^{4,5} stethoscopes,⁶ blood pressure cuffs,⁷ and auroscope earpieces⁸ have been identified as a potential source of cross infection between patients. Recent evidence has raised concern relating to contamination of tourniquets used in orthopaedics,³ due to the potential for cross infection, wound problems, and deep sepsis around implants. Our concerns relating to possible bacterial contamination of re-usable pneumatic tourniquets in our institution prompted an assessment of the degree of contamination, and methods which might be employed to reduce this.

Materials and Methods

Tourniquets in our institution have outer fabric covers, an inner silicone bladder and Velcro on the outside. They are stored rolled up in a basket in the operating theatre (Fig. 1). Twenty tourniquets subject to repeated use were sampled. Tryptone soya agar plates were used for culture. Samples from the tourniquet were taken from the internal proximal, internal distal, external proximal and external distal edges by pressing with the agar plate once only. The agar plates were then incubated for 48 h at 37°C. Growths from the plates were then documented both by the bacterial type and the colony counts.

After consultation with the infection control department, we employed Clinell wipes (GAMA Healthcare Ltd, London, UK) for cleaning five tourniquets. These wipes use quaternary ammonium compounds and a polymeric biguanide for antibacterial activity and have nine active ingredients. These active ingredients are: benzalkonium chloride, didecyl dimethyl ammonium chloride, polyhexamethylenebiguanide, dodecyl dimethyl amine oxide, phenoxyethanol, 2,4-dichlorobenzyl alcohol, disodium EDTA, phenylethanol,

Table 1 Colony counts and growths of individual tourniquets

No.	Internal proximal	Internal distal	External proximal	External distal	Total
1	25 CNS	1 CNS	7 (CNS 6, Ba 1)	2 CNS	35
2	45 CNS	87 CNS	53 CNS	> 200 CNS	> 385
3	9 CNS	16 CNS	2 CNS	6 (5 CNS, 1 Cor)	33
4	5 (1 Ba, 4 CNS)	3 (1 CNS, 2 MRSA)	4 CNS	3 CNS	15
5	31 (30 CNS, 1 Ps)	26 (1 Ba, 22 CNS, 3 MRSA)	21 CNS	15 CNS	93
6	11 CNS	3 CNS	107 (106 CNS, 1 Ba)	16 CNS	137
7	6 CNS	3 (2 Ba, 1 CNS)	6 (1 Ba, 5 CNS)	12 (10 CNS, 1 Ba, 1 Mou)	27
8	40 (2 Cor, 38 CNS)	0	39 CNS	3 CNS	82
9	6 (1 Ba, 5 CNS)	0	6 (1 Ba, 5 CNS)	7 (1 Ba, 6 CNS)	19
10	2 CNS	4 CNS	52 CNS	6 CNS	64
11	6 CNS	0	19 CNS	52 (51 CNS, 1 Ba)	77
12	7 CNS	76 (74 CNS, 2 Ba)	19 CNS	55 CNS	157
13	4 CNS	8 CNS	20 CNS	6 CNS	38
14	4 CNS	2 CNS	8 CNS	50 CNS	64
15	6 CNS	4 CNS	0	0	10
17	29 (9 CNS, 20 Staph)	0	26 CNS	14 CNS	69
18	4 CNS	14 (13 CNS, 1 Ba)	4 CNS	1 Ba	23
19	0	4 CNS	4 CNS	3 CNS	11
20	47 (42 CNS, 5 Ba)	20 CNS	> 100 (> 99 CNS, 1 Ba)	> 50 (> 45 CNS, 5 Cor, 1 Ba)	> 217
Total	241	271	> 497	> 501	1556

No., sample number; CNS, coagulase-negative *Staphylococcus* spp.; Staph, *Staphylococcus aureus*; Ba, *Bacillus* spp.; Cor, *Corebacterium* spp.;

and propylene glycol. They have both detergent and disinfectant properties, and are commonly used in our hospital for disinfecting contaminated surfaces and fabrics. Both sides of the tourniquets were cleaned by wiping four times, using a fresh wipe for each surface. Agar-plate sampling of the tourniquet was repeated from the internal proximal, internal distal, external proximal and external distal edges both before and 5 min after cleaning the tourniquet. The agar plates were again incubated for 48 h and assessed in the same fashion as before.

Results

All tourniquets in use were found to be contaminated with colony counts ranging from 9 to > 385 (Table 1). Coagulase-negative *Staphylococcus* spp. were present on every tourniquet sampled. Two tourniquets grew methicillin-resistant *Staphylococcus aureus* (MRSA), one *Pseudomonas* spp., one *Staphylococcus aureus* and one mould. Coagulase-negative *Staphylococcus* spp. were the most common organisms (96%) followed by *Bacillus* spp. (1.6%). Some plates were very contaminated and an exact count of the plate was not

possible; the counts were labelled as > 100 or > 200.

The outer (Velcro) surface of the tourniquet was nearly twice as contaminated (998 colonies in total) as the inner surface (512 colonies). Thus, the Velcro-covered surface should receive greater attention while cleaning.

There was a 99.2% reduction in contamination of the tourniquets cleaned with Clinell wipes (Table 2).

Discussion

We had suspected pneumatic tourniquets in regular and repeated use may be contaminated with bacteria. All tourniquets we analysed were found to be contaminated, sometimes quite significantly. Some of these were growths of pathological bacteria including MRSA, *Pseudomonas* spp. and *S. aureus*.

Existing published work³ concluded that 80% of reusable tourniquets were colonised with maximum colonies of coagulase-negative *Staphylococcus* spp. and *Bacillus* spp., which is comparable with our observations. However, we also demonstrated colonies of some significant pathogens such as MRSA and *Pseudomonas* spp., a finding not previously

Table 2 Colony counts before and after cleaning tourniquets

No.	Internal proximal		Internal distal		External proximal		External distal		Total	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
1	52 C*	0	50 (49 C*, 1 Ba)	0	51 (49 C*, 2 Ba)	0	50 (48 C*, 2 Ba)	1 C*	203 (198 C*, 5 Ba)	1 C*
2	29 (28 C*, 1 Ba)	0	41 (36 C*, 5 Ba)	0	12 (11 C*, 1 Ba)	0	26 (23 C*, 3 St)	0	108 (98 C*, 7 Ba, 3 St)	0
3	38 (37 C*, 1 Ba)	0	36 (34 C*, 2 Ba)	0	51 (49 C*, 2 Ba)	0	16 (15 C*, 1 Ba)	0	141 (135 C*, 6 Ba)	0
4	54 (51 C*, 3 Ba)	0	36 (34 C*, 2 Ba)	1 C*	16 (14 C*, 2 Ba)	2 (1 C*, 1 Ba)	26 (24 C*, 2 Ba)	0	132 (123 C*, 9 Ba)	3 (2 C*, 1 Ba)
5	44 (41 C*, 3 Ba)	0	36 (32 C*, 4 Ba)	0	32 (31 C*, 1 Ba)	1 C*	37 (30 Ba, 7 C*)	1 Ba	149 (111 C*, 38 Ba)	2 (1 C*, 1 Ba)
									733	6

No., sample number; C*, coagulase-negative *Staphylococcus* spp.; St, *Staphylococcus aureus*; Ba, *Bacillus* spp.

noted. By employing the simple procedure of wiping the tourniquets with disinfectant wipes, we found a 99% reduction in colonisation of the tourniquets.

Previous studies on phlebotomy tourniquets,^{4,5} stethoscopes⁶ and blood pressure cuffs⁷ have demonstrated these as potential sources for cross infection. Contamination is more worrying in relation to pneumatic tourniquets, as they are commonly employed in orthopaedic surgery where implants are frequently used with the tourniquet lying in close proximity to the operative wound.

In our study, Coagulase-negative *Staphylococcus* spp. were the most commonly grown contaminants, organisms which have been increasingly documented as a cause of surgical-site and deep infection. It is now the commonest cause of joint infection in knee replacement surgery^{9,10} and a common cause of infection in knee arthroscopy.¹¹

There are cleaning recommendations available from tourniquet manufacturers which state that cuffs can be brushed with mild soap suds and rinsed with warm water. In addition, it is possible to wash them at 60°C with commercial soap suds in a washing machine. However, they should not be spun dry. After cleaning, the fabric cuffs can be disinfected with alcohol wipes.

The Association of Operating Room Nurses (AORN) has recommended the following cleaning protocol for pneumatic tourniquets:¹² 're-usable cuffs and bladders should be cleaned, rinsed and dried between patient use according to the manufacturer's instruction and AORN recommendation. The cuff and bladder should be rinsed thoroughly to reduce cleaning solution residue which can cause allergic reaction and decrease the life of the bladder. Water should be prevented from entering the ports. More extensive cleaning with tuberculocidal disinfectant is to be used in case of blood or body fluid contamination.'

Figure 1 Tourniquets stored rolled up in a basket in the theatre.

Most hospitals do not have a protocol for cleaning tourniquets. Infection in an orthopaedic patient carries enormous costs in terms of finance, quality of life and increased burden on healthcare services.¹

Conclusions

Efforts should be made to minimise every source of contamination in theatre, especially any source which can lie close to the surgical site. We have found a 99% reduction in contamination of tourniquets by employing disinfectant wipes. This is a simple, cost-effective and quick method to clean tourniquets and we recommend the use of wipes before every case in addition to the manufacturers' guidelines for general cleaning of tourniquets.

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