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ORIGINAL STUDY

MRSA screening in orthopaedic surgery : Clinically valuable and cost effective ?

A prospective analysis of 8,867 patients

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This study aimed at assessing the prevalence of MRSA colonisation in Trauma and Orthopaedics. Risk factors, decolonisation, and subsequent infection rates were investigated. Cost-analysis of the MRSA screening program was performed. The validity and effectiveness of the MRSA screening program was reviewed.

A prospective analysis was made of all orthopaedic admissions in East Lancashire Hospital Trust. A total number of 13,155 swabs were taken in 8,867 patients in 2010.

This MRSA screening program was compared to the ideal screening criteria set out by Wilson and Junger (WHO 1968).

The MRSA prevalence in Trauma and Orthopaedics in 2010 was 0.47%. The decolonisation rate was 55%. There was no correlation between MRSA colonisation and subsequent infection. The total cost of MRSA screening at ELHT was calculated as a minimum of £ 184,170. This could extrapolate to a national expense of around £ 16 million in England and Wales in Orthopaedics alone.

The MRSA screening program did not meet 4 out of 9 screening criteria of Wilson and Junger.

The vast majority of Trauma and Orthopaedic patients are not at risk of MRSA colonisation or infection and therefore should not be screened. MRSA infection is a risk in certain high risk groups which should be screened. The MRSA screening program is ineffective when assessed to WHO standards. The program should be considered to be surveillance of MRSA, not an effective screening program for pathological MRSA infection.

Keywords : MRSA ; screening ; orthopaedics ; WHO ; cost-effectiveness.

INTRODUCTION

MRSA infection in orthopaedic surgery is a clinically important disease and is currently a media sensitive topic. MRSA screening in orthopaedics was widely introduced in 2009. It was noted anecdotally in our trust, that few patients were MRSA positive. There did not seem to be any clear association between risk factors, isolation, decolonisation and subsequent potential MRSA infection.

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WHO Screening Criteria (Wilson & Junger 1968)

1. The condition should be an important health problem
2. There should be an accepted treatment for patients with recognised disease
3. Facilities for diagnosis and treatment should be available
4. There should be a suitable test or examination
5. The test should be acceptable to the population
6. The natural history of the condition, including development from latent to declared disease, should be adequately understood
7. There should be an agreed policy on whom to treat as patients
8. The cost of case-finding (including diagnosis and treatment of patients diagnosed) should be economically balanced in relation to possible expenditure on medical care as a whole
9. Case-finding should be a continuing process and not a "once and for all" project

Fig. 1. — WHO Screening Criteria (Wilson & Junger 1968)

This questioned the effectiveness of the MRSA screening programme as applied to orthopaedic surgery. The MRSA screening policy was assessed against the widely accepted WHO criteria for a valid screening programme, set out by Wilson and Junger in 1968 (Fig. 1).

Purpose of the study

We aimed to analyse the prevalence of MRSA in our population of Trauma and Orthopaedic patients over a period of 12 months (Jan.-Dec. 2010). We aimed to analyse the effectiveness of decolonisation therapy, and any subsequent MRSA surgical site infections (SSI). We aimed to assess the MRSA carriers for any risk factors.

We aimed to perform a cost-analysis of the MRSA screening program. We also aimed to perform an analysis of the Trauma and Orthopaedic workload in order to ascertain the proportion of patients having metalwork implanted. We aimed to assess the screening program against accepted WHO criteria.

MATERIALS AND METHODS

We made a prospective study of elective and emergency orthopaedic patients admitted to East Lancashire Hospital Trust (ELHT) from 1st January 2010 to 31st December 2010. Inclusion criteria were all elective and emergency orthopaedic patients. Exclusion criteria included all patients who declined to consent (to have the skin swabbed), children under the age of 16 years and out of hospital transfers. All consenting elective orthopaedic patients were screened for MRSA via swabs from nose and groin, plus additional sites if indicated (superficial skin & wound), prior to their admission. Emergency patients were screened on admission to the ward.

Decolonisation protocol - Patients who had positive MRSA swabs were identified by the MRSA specialist nurses, and had the decolonisation protocol implemented. This consists of a 5 day course of topical Octenisan antiseptic bodywash and nasal Mupirocin. Further groin and nasal swabs are taken at the end of this period and a negative swab confirmed prior to surgery.

MRSA surgical site infection (SSI) – This is defined as a superficial or deep post-op wound infection in the post-op period of 6 weeks. Any potential SSIs were swabbed and data collected prospectively by the MRSA specialist nurses and the microbiology department at ELHT. For the purposes of this study, only MRSA SSI is considered.

The case notes of patients who were positive on MRSA screening and those who had a MRSA wound infection were reviewed to identify potential risk factors and correlate with surgical site infection.

The orthopaedic procedures between 1st January 2010 and 31st December 2010 were recorded on '*Theatre-Man*' (*36*).

Data collected was imported into Microsoft Excel spreadsheet, where basic statistical analysis was carried out.

RESULTS

There were only 42 patients colonised with MRSA. The mean age of MRSA positive patients was 65 (range : 29-89 ; 95% CI : 65 +/- 5.7). The ratio of male to female was 23 :19, and elective to emergency patients was 22 :20. There were a total of 13,155 MRSA swabs taken from various body sites in Trauma and Orthopaedic patients at ELHT in 2010.

The total number of operations carried out at ELHT in 2010 was 8,867. There were 5,225 elective patients and 3,642 trauma patients. The percentage of the orthopaedic population that was MRSA positive was 0.47% (42/8867).

Risk factors for MRSA colonisation : Fifty percent of elective and 38% of emergency patients had recorded previous hospitalisations. Twenty seven percent of elective and 14% of emergency patients had previous antibiotic therapy. Fifty nine percent of elective and 43% of emergency patients had previous surgery. Nine percent of elective and 0% of emergency patients had previous positive MRSA swabs. Five percent of elective and 10% of emergency patients presented from nursing homes. There were 16 patients with no risk factors, 11 with 1 risk factor, 9 with 2 risk factors, 5 with 3 risk factors and one with 4 risk factors.

Success of decolonisation : 33/42 patients received decolonisation therapy. Of these 33 patients, 18 were successfully decolonised, confirmed with a negative swab after treatment. Of the 42 patients that were carriers for MRSA, 24 had surgery without achieving a negative swab. Whether or not the patients received decolonisation, or were successfully decolonised, none of these patients developed MRSA surgical site infection (SSI). There were no MRSA surgical site infections at ELHT in 2010.

Procedure breakdown : In elective surgery, there were 1,429 procedures with insertion of metalwork (this includes all arthroplasty, arthrodesis, osteotomy and revision procedures), there were 1,388 injections and aspirations, 979 arthroscopic procedures and 1,409 soft tissue procedures. In trauma surgery, there were 2,800 operations involving insertion of metalwork and 841 with no metalwork inserted.

Cost of MRSA screening at ELHT in 2010

The cost of analysis of MRSA swab was £ 7.50 (includes wholesale cost of raw materials and analysis at ELHT) (*11*). The cost associated with clinical risk assessment was £ 3.95 (*33*). The cost associated with taking patient swabs was £ 2.55 (*33*). Therefore, total cost per swab was £ 7.50 + £ 3.95 + £ 2.55 = £ 14. There was also the cost of decolonisation. The combined cost of 5 day treatment with Octenisan and Mupirocin was £ 6.95 (*11*). In 2010 the total cost to ELHT was : 13,155 swabs taken in 2010 × £ 14 per swab = £ 184,170. The cost of decolonisation was £ 6.95 × 42 = £ 292. The cost of screening patients requiring metalwork was £ 89,863 and the cost of screening patients not requiring metalwork (potential saving) was £ 94,307

There are 168 Acute NHS trusts in England (*23*). Therefore not screening orthopaedic patients who are not having any metalwork inserted could potentially save 168 × £ 94,307 = £ 15,843,576**.**

In a 12 month period from August 2010 to July 2011, there were 17.2 million finished consultant episodes (FCEs), 58.3% of which i.e. 11.1 million required at least one procedure or intervention, and 5.7 million of these were day cases (*9*). Assuming all patients are to be screened for MRSA, cost of screening for the NHS in England = 17.2 million × £ 14 = £ 240,800,800.

Validity of the MRSA screening program

Is the MRSA screening program valid, when compared to the criteria of Wilson and Junger 1968 (Fig. 1) ? We examine these criteria below :

1. Is MRSA an important health problem ? – Yes.

There is a distinct difference between MRSA colonisation and MRSA infection. A peri-prostheic joint infection with MRSA can be devastating with life-threatening complications. In surgical treatment

of peri-prosthetic infection in total hip or knee arthroplasty caused by MRSA, debridement controlled the infection in only 37% of cases whereas two-stage exchange arthroplasty controlled the infection in 75% of hips and 60% of knees (*25*). This highlights the difficulty in treatment of these patients, of which multiple operative procedures carry increased morbidity and mortality risks, especially in the chronically ill and elderly patients and in those requiring intensive care. The consequences, both economic and physical, are costly. Revision surgery for deep infection is very expensive (*15*). In patients treated with arthroplasty or metal implants, MRSA infection is an important health problem in which all measures should be undertaken in the prevention of deep infection.

2. Is there an accepted treatment for patients with the recognised disease ? – NO.

In our population of patients, 55% of patients were decolonised with Octenisan and Mupirocin, which is a standard treatment for decolonising patients with MRSA colonisation. Fifty-six percent of patients went on to have their procedure without a confirmed negative swab. This means that either they were not decolonised in the first place (9/42 pts) or that the decolonisation did not eradicate the MRSA colonisation (15/42 pts). None of these patients went on to develop an infection.

A systematic Cochrane review carried out in 2003, looking at 6 studies which met the inclusion criteria, showed insufficient evidence to support use of topical or systemic antimicrobial therapy for eradicating nasal or extra-nasal MRSA. There was no demonstrated superiority of either topical or systemic therapy, or of combinations of these agents, when compared to placebo. It also stated that potentially serious adverse events and development of antimicrobial resistance can result from decolonisation therapy (*17*).

3. Facilities for diagnosis and treatment should be available – Yes.

There are pathology laboratories available to all NHS trusts, capable of analysing MRSA swabs. MRSA treatment usually depends on the site of infection (i.e SSI or bacteraemia). The treatment is antibiotic therapy and surgical debridement ; with glycopeptides, such as Vancomycin, used as first-line for serious infections (*4*).

4. There should be a suitable test or examination – Yes.

Studies in the literature that meet the criteria set out be Brown *et al* (*1*) show a range of sensitivities 96%-100% and specificities between 92%-99% (*3, 10,24,32,38*).

The current MRSA chromogenic medium (used at ELHT) is stated by Biomerieux (the supplier) to have a sensitivity of 89% and a specificity of 97.1% (at 24hr incubation). Sensitivity at 18hr is 80% (specificity not affected by incubation time) (*27*). This would suggest that the test available is a suitable test for diagnosing MRSA colonisation.

5. The test should be acceptable to the population – Yes

The MRSA screening test is a culture swab taken from the nose and the groin. This is non-invasive, does not put the patient at risk and is generally acceptable to the population.

6. The natural history of the condition, including development from latent to declared disease, should be adequately understood – NO

There are studies in the literature which define the proportion of MRSA colonised patients who went on to develop an MRSA infection. These studies look at the risk of developing an infection in certain groups of patients, and by no means can be extrapolated and applied to the general population (*7*). The risk of development of MRSA infection varies from group to group. For example, studies conducted in orthopaedic patients show rates from 0% by Khan *et al* (*13*), 4.4% by Scott *et al* (*31*) and 18% by Levy *et al* (*16*). Our MRSA infection rate was 0% from 8867 patients screened. This is in contrast to ICU populations which show rates from 27% by

Garrouste-Org *et al* (*6*) to 67% by khurram *et al* (*14*), with a number of studies falling in between these figures (*1,12,19,28,37*). Bert *et al* (*23*) showed that 87% of MRSA colonised patients went on to develop an MRSA infection in liver transplant patients. This may reflect the difference in the risk profiles of orthopaedic cases and high risk groups such as ITU and liver transplant patients.

7. There should be an agreed policy on whom to treat as patients – NO

In the original 2006 DOH document called "Screening for Meticillin-resistant *Staphylococcus aureus* (MRSA) colonisation : A strategy for NHS trusts : a summary of best practice" (*30*), certain surgical specialties, including Trauma and Orthopaedics as were to be "screened" or as Wilson and Junger put it "treated as patients" carrying the disease. This was changed in the 2010 DOH document, "The operating framework for the NHS in England 2010/2011" (*34*) to include all patients being admitted to hospital. We believe that all patients should not be 'screened' for the MRSA organism. Only orthopaedic patients who are in the high-risk category, i.e. ICU patients and patients in whom any metalwork is being surgically implanted should be screened. There is no clear consensus as to whom to treat as patients.

8. The cost of case-finding (including diagnosis and treatment of patients diagnosed) should be economically balanced in relation to possible expenditure on medical care as a whole – NO

The cost of case finding in our trust in Trauma and Orthopaedics alone in 2010 was £ 184,170. There were no cases of MRSA infection in our population of 8867 patients that were screened, in which only 0.47% were carriers. We believe that the cost of case finding is not economically justifiable in our population (soft tissue surgery). The cost of revision surgery in infected total hip arthroplasty is quoted as 3.6 times more than primary total hip arthroplasty (*15*). This high cost may justify screening arthroplasty patients.

9. Case-finding should be a continuing process and not a "once and for all" project – Yes

The current screening program is ongoing and not a "once and for all" project, therefore this criterion is met.

To summarise, we do not believe the MRSA screening program to be a valid one, when assessed using the 1968 WHO Wilson and Junger criteria (*39*). Based on our assessment, it does not fulfil 4 out of 9 criteria for a valid screening program.

DISCUSSION

From our study, it is clear that MRSA prevalence in the orthopaedic population at ELHT is extremely low, i.e. 0.47%. It is also clear that there does not seem to be any relationship between risk factors for MRSA colonisation, decolonisation treatment, isolation and development of an MRSA surgical site infection.

The prevalence of MRSA has increased considerably since the 1990s (*29*) and there is a great variation in prevalence across Europe with rates reported as < 1% in Scandinavia to > 40% in Southern Europe (i.e. 0.2% in Norway and 49% in Greece) (*35*).

There is difficulty ascertaining accurate prevalence, due to the fact that surveillance data is usually derived from MRSA outbreak situations (*18*). Also, as MRSA prevalence is calculated by taking swabs from patients only on admission to hospital or from patients who are at increased risk, the rates calculated cannot reflect the true case load of the hospital or any clinical setting (*7*).

There is a large body of literature documenting MRSA colonisation / prevalence rates in many different environments. These range from nursing homes to ICU. The prevalence in the literature ranges from as little as 1.3% in elective orthopaedic patients (*25*), 0.47% in our study to 21.5% in ICU (*20*), 27% in vascular surgery (*21*) and 70% in nursing homes. The prevalence in our population was 0.47%. It can be concluded that some environments / hospital specialties seem to have higher MRSA colonisation rates than others, with Intensive Care Units having the highest prevalence rates in the hospital setting (*20*).

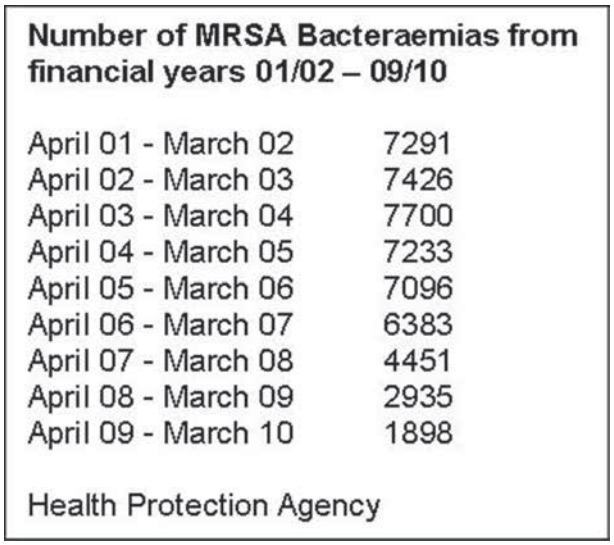

Fig. 2. — Number of MRSA Bacteraemias from financial years 01/2002 – 09/2010.

MRSA colonisation in itself is not a disease process. It is known that colonisation may lead to the pathologic state of infection in certain individuals i.e. the elderly, the chronically ill, the patients on ICU wards. For the rest of the population, being an MRSA carrier has no adverse consequence. It is also accepted that if a patient develops an MRSA infection, the infection can be difficult to treat, particularly when metalwork has been implanted.

MRSA bacteraemias have decreased considerably over the past 3-5 years, as seen in Fig. 2 (*22*). This does not appear to be a consequence of the recent MRSA screening program. The changes implemented in 2001 i.e. protocols to manage MRSA outbreaks, hand washing, deep cleaning wards and beds, and more judicious antibiotic prescribing (*22*), appear to be directly responsible for the excellent results seen in reducing MRSA bacteraemias. The MRSA screening program was introduced in 2009 and a progressive reduction in case numbers had already occurred prior to this. The true effect of this screening is difficult to gauge due to the changes enacted in 2001 (a major confounding factor).

CONCLUSIONS

Due to the low MRSA prevalence in this orthopaedic population i.e. 0.47%, and the 0% MRSA infection rates, individuals who do not require metalwork implants, need not be swabbed for MRSA, as they are low risk. This includes all joint injections, arthroscopies, and soft tissue procedures, which represent > 50% of the orthopaedic work. This could result in a saving of £ 94,307, in our hospital trust. Currently, we would recommend that patients having metal-work inserted for trauma or an elective procedure should be screened until more data on the consequences of MRSA skin colonisation with the surgical implantation of metal (fracture fixation or prosthetic joints) are known.

We have also shown that the MRSA screening programme, which will soon include every patient coming into contact with the NHS, does not meet 4/9 of the widely accepted criteria laid out by Wilson and Junger (*39*). We recommend that the MRSA "screening" program should be re-assessed by the DOH, to include only high risk groups of patients. This could result in a substantial saving to the NHS.

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