The burden of bone, native joint and soft tissue infections on orthopaedic emergency referrals in a city hospital

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ABSTRACT

INTRODUCTION Bone, native joint and soft tissue infections are frequently referred to orthopaedic units although their volume as a proportion of the total emergency workload has not been reported previously. Geographic and socioeconomic variation may influence their presentation. The aim of this study was to quantify the burden of such infections on the orthopaedic department in an inner city hospital, determine patient demographics and associated risk factors, and review our current utilisation of specialist services.

METHODS All cases involving bone, native joint and soft tissue infections admitted under or referred to the orthopaedic team throughout 2012 were reviewed retrospectively. Prosthetic joint infections were excluded.

RESULTS Almost 15% of emergency admissions and referrals were associated with bone, native joint or soft tissue infection or suspected infection. The cohort consisted of 169 patients with a mean age of 43 years (range: 1–91 years). The most common diagnosis was cellulitis/other soft tissue infection and the mean length of stay was 13 days. Two-thirds of patients ($n=112$, 66%) underwent an operation. Fifteen per cent of patients were carrying at least one blood borne virus, eleven per cent were alcohol dependent, fifteen per cent were using or had been using intravenous drugs and nine per cent were homeless or vulnerably housed.

CONCLUSIONS This study has shown that a significant number of patients are admitted for orthopaedic care as a result of infection. These patients are relatively young, with multiple complex medical and social co-morbidities, and a long length of stay.

KEYWORDS

Infection – Psychosocial deprivation – Urban hospitals – Orthopaedics – Infectious diseases – Interdisciplinary communication

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Infections in bone and joints can have devastating long-term consequences resulting in extensive inpatient investigation, multiple operations, prolonged antibiotic courses, and inpatient and community rehabilitation. This leads to increased direct costs for the healthcare provider and decreased earnings for the patient. While there are variations between trusts and units, the financial cost of infection in total hip and total knee arthroplasty averages £70,000 per patient.¹

The prevention, diagnosis and treatment of periprosthetic joint infections along with their impact on orthopaedic resources and society remain some of the most closely studied subjects for the orthopaedic community worldwide.^{2–4} The focus of study tends to be pathogen, site or risk factor specific, such as the use of intravenous drugs.^{5–7} Such infections can be a regular source of emergency referral or admission to specialist units and may require a variety of interventions ranging from the administration of

antibiotics to extensive surgical procedures.^{8,9} However, beyond this group of infections, there is also a burden of bone, native joint and soft tissue infection, in which prevalence, patient demographics and risk factors have often only been studied in isolation. A holistic capture of data on such a group of patients receiving treatment in an orthopaedic unit has not, to our knowledge, been undertaken previously.

In 2012–2013, 121,049 patients were seen in the emergency department of our institution. The hospital serves the London boroughs of Camden and Islington, representing some of the most deprived areas in London for homelessness and inequality in life expectancy.¹⁰ The catchment area is estimated to cover a population of 410,000 patients. The complexity of the patient demographic has led to the development of a local network of specialist services aimed at improving the health of patients who are homeless, patients with addiction, patients with blood borne viruses,

Figure 3 The operations carried out as well as the number of those managed non-operatively

Figure 4 The range of co-morbidities

and facilitating reduced admission rates and early discharge, with significant rates of success.¹¹ Nevertheless, we believe that our inner city location and patient population lead to a disproportionate pattern of emergency referrals and admissions under our teams in trauma and orthopaedics.

Similar observations have been reported in a specific cohort of necrotising soft tissue infections in a metropolitan UK population.¹² Variation in patient and disease characteristics attributable to the metropolitan nature of their catchment area compared with other countries and more rural settings means that certain diagnostic scoring systems designed with non-UK datasets should be used with caution.

The primary aim of this study was therefore to quantify the burden of bone, native joint and soft tissue infection in

terms of referral and emergency admissions to our unit. The study also sought to determine the patient demographics, co-morbidities and utilisation of specialist services during the treatment of such patients.

Methods

A prospectively collected database was reviewed for all admissions under the trauma team in our unit during 2012. The recorded patient details, diagnosis, investigations and results, management plans, length of stay and discharge details were collated. Any patients referred to or admitted under the on-call trauma and orthopaedic team with a query of bone, native joint or soft tissue infection were included in the study. Prosthetic joint infections were excluded as their care is provided by our specialist

arthroplasty service and periprosthetic infections were not a feature in our study. Similarly, diabetic foot ulcers and infections were excluded as these are managed by a dedicated diabetic foot multidisciplinary team (MDT), of which the senior author is a member. Demographic data included age, sex, home postcode and ethnicity, as recorded on our hospital database. Those patients without a home address were classified as having no fixed abode.

Diagnosis of infection was made where a patient presented with local or systemic symptoms and signs, responded to appropriate medical and surgical management, and/or had positive microbiological specimens on laboratory records. Final diagnoses were grouped into categories including abscesses, septic arthritis, osteomyelitis, necrotising fasciitis, cellulitis, infected wounds, infected ulcers, infected haematomas, infected cysts, infected metal-work, tropical infections and animal or human bites. Cases were also recorded if they were referred for suspected infection and the final diagnosis included inflammatory arthropathy, combined pathologies or was unknown. Involvement of the relevant MDT members was ascertained by an explicit reference to their role in the computerised discharge summary. Co-morbidities, including alcohol and drug use, were ascertained from medical and laboratory records. Local statistical data and geographic indices of social deprivation were obtained from Camden Council and Trust for London.

Results

Out of 1,190 emergency admissions and referrals to the department during the study period, 169 patients (15%) fulfilled the inclusion criteria of having a suspected bone, native joint or soft tissue infection (Fig 1). The mean age at admission was 45 years (range: 1–91 years) with a male-to-female ratio of 1.4:1. The final diagnoses at point of discharge are demonstrated in Figure 2. The most common diagnoses were cellulitis, abscesses, septic arthritis and osteomyelitis.

Figure 3 shows the operative interventions required. One hundred and twelve patients (66%) required operative management. The mean length of hospital stay was 13 days. The maximum length of stay was 122 days and 5 patients were admitted to hospital for more than 100 days. Two of those patients were dependent on alcohol and intravenous drugs. In the whole study group, 26 patients (15%) were documented as currently using or having previously used intravenous drugs. Fifteen (9%) were receiving methadone prescriptions. Thirty-one patients (18%) had a psychiatric diagnosis, which included alcohol abuse disorder. The range of co-morbidities is shown in Figure 4.

Ten patients (6%) were of no fixed abode. Five (3%) were living in a hostel designated to support individuals without a home. Sixty-five patients (38%) lived in the catchment area of the hospital while forty-eight (28%) lived in other London boroughs. Fifteen patients (9%) lived in other areas of the UK and nine (5%) lived abroad.

Two patients (1%) received input from the specialist drug and alcohol liaison team, and one patient (1%) was

seen by the specialist homeless team. The specialist infectious diseases physicians saw 26 (15%) of the patients and 17 patients (10%) had input from a microbiologist.

Discussion

This study examined the burden of bone, native joint and soft tissue infection on orthopaedic emergency referrals and admissions, taking a holistic approach to assess the complex medical and social needs of these patients as well as how we currently use specialist services to meet these needs and improve overall care. This group of patients accounted for 15% of all emergency admissions or referrals. This is equivalent to one full day of admissions per week at our unit. The needs of this cohort of patients can vary considerably from those of many other trauma patients.

A wide variety of infection related diagnoses was encountered, the most common being cellulitis and lower limb abscesses, which is similar to other studies looking at infections in intravenous drug users.^{7,13,14} Despite the wide variety and significant proportion of infection related admissions, however, only 112 (66%) of these patients required operative management, which raises the question of whether a surgical team should lead patient care in almost a third of these cases.

Levell *et al* reported that their dermatology-led cellulitis clinic for secondary care emergency admissions resulted in improved accuracy in initial diagnosis, increased diagnosis of other underlying skin conditions and increased savings in treating cellulitis.¹⁵ As with fragility fracture care, where access to an orthogeriatrician is recognised to be best practice with improved care of a high risk and vulnerable patient group, so the care of patients with infection should have access to other specialties.¹⁶ Copley *et al* showed that by instigating a multidisciplinary approach to the care of children with osteomyelitis, including infectious disease specialists, there was a significant decrease in length of stay, readmission rates and the number of antibiotic changes during treatment.¹⁷

In 2012 our institution did not have a policy or formalised multidisciplinary approach to native orthopaedic infection. An infectious diseases or microbiology specialist opinion required formal referral from a member of the admitting team. It may be that our low rate of referral and multidisciplinary care plans reflects this as junior doctors involved in receiving referrals from the emergency department may not have been aware of the team of infectious disease specialists, which is not present in many hospitals, or they may not have considered the referral necessary. Given the clear benefit shown with a multidisciplinary approach and the significant proportion of cases that can be successfully managed non-operatively, it may be appropriate to initiate an automatic process of referral in cases of bone, native joint or soft tissue infection, or at least inclusion in a regular MDT meeting.

This cohort of patients was, in the main, of working age with a mean age of 43 years. A lengthy hospital stay and any long-term consequences of infection will have

significant financial costs for the patient. Many forms of state support are stopped or decreased when a patient is admitted to hospital and unemployment rises.¹⁸ In inner London in 2011, of those whose day-to-day activities were significantly limited, 79% were unemployed and 75% were economically inactive.¹⁰

The average length of stay (13 days) far exceeds the figures quoted for some of the most frequently performed elective orthopaedic procedures (6.9 days after primary hip replacement and 6.6 days after primary knee replacement).¹⁹ For some patients, this was due to the severity of their infection and subsequent prolonged hospitalisation for treatment. However, for others, there were complicated social matters. For example, two of our patients with prolonged hospital stay required long-term intravenous antibiotics but could not be discharged with a central line to receive their treatment at home because of a history of intravenous drug use (IVDU). There was also a significant proportion of homeless people and individuals who were vulnerably housed (9%). These patients must be provided with safe and appropriate housing before they can be discharged, a process that is invariably challenging and time consuming.

Prolonged length of stay is an independent variable in the overall cost of healthcare.²⁰ It is associated with both additional financial costs and a negative effect on the availability of resources for the management of other pathologies.²¹

When dealing with a group as diverse as the one in this study, addressing the issues behind the prolonged length of stay is unlikely to be successful with a single intervention. Outpatient administration of intravenous antibiotics, MDT involvement during hospitalisation and when planning discharge, and contribution by specialist teams in patients with human immunodeficiency virus (HIV), hepatitis, homelessness and alcohol abuse disorder are some of the interventions that have been proven to help reduce the in-hospital burden from severe infections.^{11,17} Involving doctors with infectious disease and microbiological training decreases the length of antibiotic administration as well as the antibiotic cost per admission, which Coello *et al* found to be the second largest contributor to cost in treating hospital patients with infection.²⁰

Although 35% of patients in the cohort had no co-morbidities, it was common for patients to have one or multiple recognised risk factors for infection. The large burden of psychiatric illness was particularly evident, with 18% having a psychiatric diagnosis, the most common being alcohol abuse disorder. Furthermore, this percentage is likely to be an underestimate as this information would only have been included in the hospital documents used in this study for patients who openly admitted to psychiatric illness, alcohol and drug abuse. Studies of the adverse psychiatric effects of infection on patients in hospital have focused on isolation and loneliness, experience from infection control precautions and its negative psychological effects on patients.²²

The phenomenon of drug abuse and its repercussions on non-orthopaedic specialist services has been studied previously.^{7,8,15} Orthopaedic units have also reported their experience treating the sequelae of drug abuse. Henriksen

et al treated 89 IVDU patients during 145 hospitalisations focusing on soft tissue sequelae, with 58 superficial abscesses, 27 deep abscesses and 57 cases of cellulitis accounting for the majority of their workload.¹⁴ They concluded that best practice should involve antimicrobials, microbiological analysis and surgical exploration, and revision was to be followed by active wound care.

More recently, Allison *et al* reported on the microbiology of orthopaedic related infections secondary to drug abuse.²⁵ They reviewed 215 patients over 7 years, and found a high incidence of osteomyelitis (59%) and a pre-dominance of Gram positive bacteria. Wang *et al* compared the demographics, presentation, treatment and outcomes of surgically treated primary pyogenic infections of the spine between IVDU and non-IVDU patients.⁹ The IVDU group required more complex surgical management, had a higher incidence of surgical site infections, and were found to be unreliable during treatment and the follow-up period.

Reviewing the IVDU subgroup of patients in isolation was beyond the scope of this study. Nevertheless, our experience of the challenges in the overall management of these patients, including their complex presentation, co-morbidities and social circumstances, is mirrored closely by the reports from other units.

There were no new cases of diabetes, HIV, hepatitis or tuberculosis in our study cohort. In a region in which the prevalence of each of these is higher than the national average, this is a surprising result.^{24–26} Story *et al* showed that homeless people, prisoners and problem drug users collectively comprise 17% of London's tuberculosis cases.²⁷ The prevalence in London is 27 per 100,000 population. Among the homeless population it is 788 per 100,000 and for problem drug users, it is 354 per 100,000.

Our lack of new diagnoses in such a high risk cohort of this size, together with low rates of referral to infectious disease specialists, would suggest that treatment was prioritised over investigating for immunodeficiency; further postgraduate education as well as close teamwork with infectious disease and diabetes specialists will benefit patient outcome. Consideration should therefore be given to developing a policy to investigate for blood borne viruses and causes of immunodeficiency in patients with infection in bone, native joints and soft tissue in the future.

In London there are estimated to be 10,000 single homeless people living on the streets or in hostels.²⁷ Homeless patients are admitted 3.2 times as often as those who are not homeless.¹¹ Patients with no home were also over-represented in our study. Engaging specifically in issues surrounding homelessness has been shown to decrease the total number of bed days, decrease rates of readmission, improve discharge planning and decrease total cost.¹¹

Study limitations

There are some limitations to this study. It relies on our prospectively collected data, electronic records and discharge summaries. We did not have access to the hospital notes and appreciate that there may have been evidence for documented consultations that were not registered in our dataset. The retrospective review of the data is a

potential source for inaccuracies, in terms of both the actual prevalence of the problem and the relevant demographic characteristics. Our perception is that the reported prevalence may be an underestimate due to some of the referrals being documented incorrectly in the initial electronic records. Nevertheless, our data highlights the disproportionate burden on our cohort of admissions.

Furthermore, the findings of this study are a reflection of the local population. As a result, the relatively high number of IVDU, alcohol dependent and HIV/hepatitis positive patients may not be representative of other parts of the country, with the overall burden of bone, native joint and soft tissue infection smaller than that reported here.

Conclusions

This study demonstrates that infections of bone, native joint and soft tissue are a frequent cause for referral and admission to an orthopaedic unit. The patient characteristics can be an added source of increasing complexity during the treatment. Engagement of other relevant services, both medical and social, might prove crucial in reducing the overall burden on the orthopaedic specialists.

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