RATIONAL IMAGING

Investigating suspected bone infection in the diabetic foot

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Accurate and early diagnosis of this condition is key to successful management. This article guides you through the diagnostic options

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Cite this as: *BMJ* 2009;339:b4690
doi: 10.1136/bmj.b4690

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Clinical review. Managing complications of the diabetic foot (2009;339:b4905)

This series provides an update on the best use of different imaging methods for common or important clinical presentations. The series advisers are Fergus Gleeson, consultant radiologist, Churchill Hospital, Oxford, and Kamini Patel, consultant radiologist, Homerton University Hospital, London.

A 58 year old man with long standing type 2 diabetes presented with a non-healing ulcer on the side of the right great toe, with associated spreading cellulitis. Laboratory tests showed a white blood cell count of 11.3×10^9/l (normal range 3.2-9.8), a neutrophil count of 5×10^9/l (3-5.8), and an erythrocyte sedimentation rate of 45 mm/h (normal <15). He had a history of peripheral neuropathy, peripheral vascular disease, and renal failure caused by diabetic nephropathy. He was referred for imaging of suspected osteomyelitis.

Osteomyelitis of the foot is a common and challenging problem in patients with diabetes.[1] Around 25% of patients with diabetes will develop a foot ulcer, usually at areas of pressure, such as the heel or metatarsal heads.[2] Osteomyelitis is almost always caused by contiguous spread of infection from overlying foot ulceration and complicates up to 20% of ulcers.[3]

The two major difficulties in diagnosing diabetic foot osteomyelitis are that imaging tests can be insensitive to early disease and that bony changes related to neuroarthropathy (Charcot's foot) can mimic infective change. Accurate and early diagnosis of this condition is the key to successful management, which may include prolonged treatment with antibiotics or surgical resection.[4 5]

Clinicians should suspect osteomyelitis when a foot ulcer is deep, the ulcer fails to heal despite appropriate offloading and perfusion, or when bone is visible or palpable with a metal probe. Laboratory tests have limited value and must be interpreted together with the clinical picture. An erythrocyte sedimentation rate of more than 70 mm/h increases the likelihood of osteomyelitis, especially if the ulcer is deep,[6] but the white cell count is an unreliable indicator. The diagnosis of osteomyelitis is usually based on a combination of clinical and imaging tests, but the criterion standard is the isolation of pathogens or demonstration of classic histopathological changes on bone biopsy.

LEARNING POINTS

- Diabetic foot osteomyelitis is invariably accompanied by foot ulceration
- Plain radiography should be the first imaging test used but may not show changes for up to two weeks
- Magnetic resonance imaging is the most accurate imaging modality
- Nuclear medicine scans play only a modest role in the diagnosis
- Bone biopsy is the criterion standard for the diagnosis of osteomyelitis but is not needed in every case

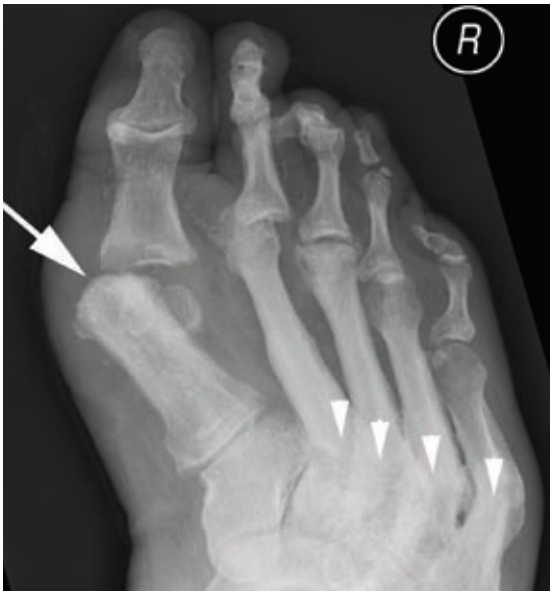

Fig 1 | Plain radiograph showing subluxation of the first metatarsophalangeal joint, with loss of the normal cortical outline of the first metatarsal head and sclerosis (arrow). Minor lucency is seen at the base of the proximal phalanx of the great toe. There are multiple old fractures of the metatarsals and arthropathy of the second and third metatarsophalangeal joints indicating neuroarthropathy (arrowheads). The findings are suspicious for, but not diagnostic of, active osteomyelitis

What tests should be performed?

Plain radiography

Plain radiographs of the foot, taken in at least two different projections, should be the initial imaging test (fig 1).[4 7] Typical findings of early osteomyelitis are focal lucency of the bone, with loss of the trabecular pattern and cortical destruction. As osteomyelitis evolves, radiographs may show periosteal reaction, sclerosis, and new bone formation.

The sensitivity of radiographs for diagnosing osteomyelitis ranges from 22% to 75%,[8 9] mainly because changes may not occur until around 50% of the bone is demineralised, which can take more than two weeks. Furthermore, coexisting neuropathic arthropathy or trauma can mimic osteomyelitis. Despite these limitations, radiographs play a vital role in the first line diagnosis of osteomyelitis, because their specificity is relatively high in uncomplicated cases. Radiography is also useful when following suspected infection, because serial changes may show osteomyelitis or bony healing.

If the initial radiographs are normal but osteomyelitis is still suspected, it may be helpful to repeat the test two to four weeks later. If classic changes are present then bone infection is highly likely. If the changes are equivocal, or coexisting neuroarthropathy or trauma is present, further imaging is advised.

Magnetic resonance imaging

Magnetic resonance imaging—with its lack of ionising radiation, excellent contrast resolution, and multiplanar capability—is the imaging modality of choice for the evaluation of diabetic foot infection. Even if radiographs suggest osteomyelitis, magnetic resonance imaging is useful for evaluating the extent of disease and for guiding treatment.

Osteomyelitis manifests as focal decreased signal on a T1 weighted sequence, with increased signal on a corresponding T2 weighted fat suppressed or short tau inversion recovery sequence (figs 2 and 3). A cortical breach or intraosseous abscess may also indicate osteomyelitis.[5] No convincing evidence exists that intravenous gadolinium increases the accuracy of diagnosis of osteomyelitis, but it does improve the evaluation of soft tissue pathology, thereby helping to demonstrate abscesses, synovitis, and sinus tracts.[10 11]

Magnetic resonance imaging has an overall sensitivity of about 90% (range 80-100%), with a specificity of about 80% (40-100%) for the diagnosis of diabetic foot osteomyelitis; overall accuracy is around 89%.[12] A positive magnetic resonance imaging result greatly increases the likelihood of osteomyelitis (likelihood ratio 3.8), whereas a normal result makes osteomyelitis much less likely (0.14).[12] Meta-analyses show that magnetic resonance imaging outperforms plain radiography and nuclear medicine studies in the diagnosis of this condition.[13]

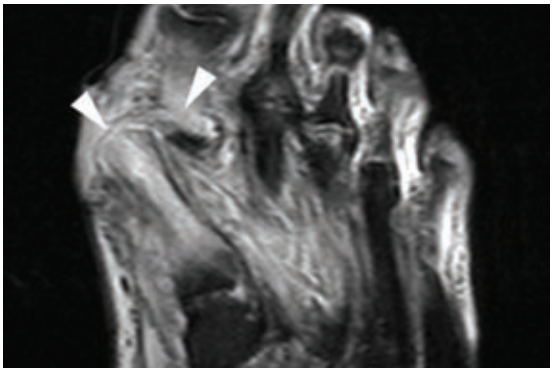

Fig 2 | An axial short tau inversion recovery image showing high signal in the soft tissues adjacent to the first metatarsal head at the site of ulceration. High signal is seen in the first metatarsal and proximal phalanx of the great toe (arrowheads); this is compatible with osteomyelitis and joint sepsis

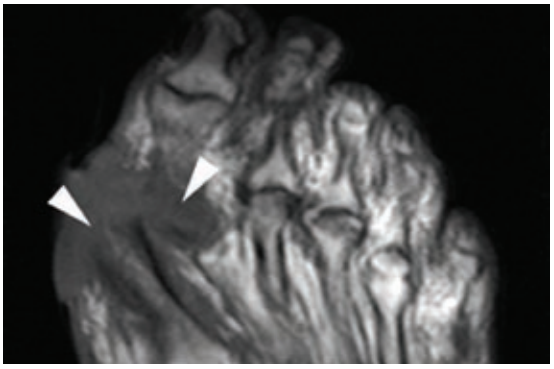

Fig 3 | An axial T1 weighted image showing cortical destruction and low signal marrow change, compatible with osteomyelitis (arrowheads)

Other tests to consider

If the plain radiograph is equivocal and magnetic resonance imaging cannot be performed, clinicians should consider other tests.

Computed tomography

Advances in computed tomography technology—including the ability to perform reformats in any plane without loss of resolution—enable better evaluation for cortical erosions, focal areas of lucency, and sequestra than is possible with radiography. However, soft tissue contrast is poor compared with magnetic resonance imaging. In most circumstances, computed tomography provides only limited additional information over radiography and is not routinely used.

Triple phase technetium-99 MDP bone scan

The triple phase technetium-99m methylene diphosphonate (MDP) bone scan has greater sensitivity than radiography in diagnosing osteomyelitis but has limited value because of its high false positive rate.[14] Soft tissue infection, neuroarthropathy, degenerative changes, and fractures may result in increased uptake and mimic osteomyelitis. Its sensitivity for the detection of diabetic foot osteomyelitis is about 90% (range 50-100%), but it is not generally recommended because specificity is only around 46% (18-100%).[13 14]

White blood cell and antibody scans

The sensitivity of white blood cell scans and antibody scans is about 86% (range 72-100%) and 93% (67-98%), respectively.[13] These scans have a slightly lower sensitivity but substantially higher specificity than the triple phase ^{99m}Tc MDP bone scan. Investigations comparing labelled white cell imaging alone with labelled white cell imaging plus bone scan show that the combined study has only marginally increased accuracy.[14] White cell scans have a modest role in diagnosing diabetic foot osteomyelitis but may be useful if magnetic resonance imaging cannot be performed.

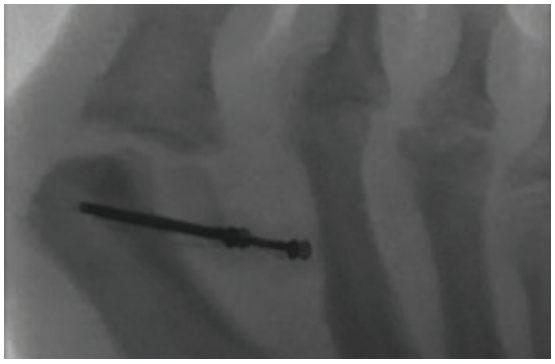

Fig 4 | A fluoroscopic image showing percutaneous biopsy of the first metatarsal head using a 14 gauge bone biopsy needle

Fluorine-18-fluorodeoxyglucose positron emission tomography

Fluorine-18-fluorodeoxyglucose, a marker for increased intracellular glucose metabolism accumulates at sites of infection and inflammation.[15] Combined with computed tomography, the technique allows precise anatomical localisation of increased isotope uptake, thereby improving the differentiation between osteomyelitis and soft tissue infection.[16] Few studies have been performed, however, and further investigation is needed before this test can be recommended.[17]

Ultrasound

Ultrasound has limited value in evaluating diabetic foot osteomyelitis. Nevertheless, it is useful for evaluating the soft tissues and guiding aspiration or soft tissue biopsy.

Bone biopsy for culture and histology

Bone biopsy is recommended if the diagnosis of bone infection remains in doubt after imaging, if empirical treatment with antibiotics fails, if a multidrug resistant organism is suspected, or if a metallic implant is planned for the suspect bone. Deep needle punctures and swab cultures are unreliable in comparison and are not recommended.

Treatment is more likely to be successful if the choice of antibiotic is based on the results of bone culture. Samples can be obtained percutaneously under imaging guidance or by open surgery. Antibiotics should be stopped for at least 48 hours before biopsy to increase the yield of cultures. Scrupulous aseptic technique is needed to avoid contamination. We recommend using at least a 14 gauge bone biopsy needle. At least two bone samples should be obtained, and these should be sent for microbiology and histology. Although safe to perform, bone biopsy is not widely used.

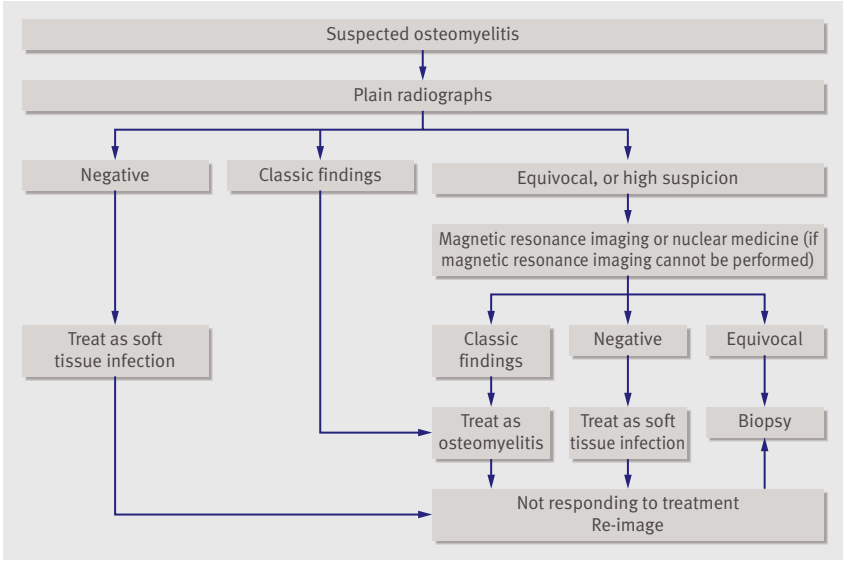

Fig 5 | Suggested imaging algorithm for suspected foot osteomyelitis in diabetes

Outcome

Because the ulcer failed to heal over seven weeks despite appropriate care, including broad spectrum antibiotics, the patient underwent fluoroscopic guided percutaneous biopsy of the first metatarsal head (fig 4). A culture of the bone sample grew *Staphylococcus aureus*, which was found to be sensitive to flucloxacillin. The histopathology sample was crushed and considered non-diagnostic. After a six week course of oral flucloxacillin the ulcer eventually healed. Figure 5 shows a suggested imaging algorithm for suspected foot osteomyelitis in diabetes.

Contributors: JT selected the patient, searched the literature, wrote the paper, and chose the images. TB and BAL helped edit and prepare the final draft.

Competing interests: None declared.

Provenance and peer review: Commissioned; externally peer reviewed.

Patient consent obtained.

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A PATIENT'S JOURNEY

Behçet's syndrome

Michael Hart,[1] Robert J Moots[2]

Finding an effective treatment for Behçet's syndrome has been a long and painful journey for Michael

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Cite this as: *BMJ* 2009;339:b3876
doi: 10.1136/bmj.b3876

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I was 18 and had just returned from a trip to Australia when lumps started to appear on my legs. The doctors thought it was deep vein thrombosis caused by the long flight and prescribed anti-inflammatory drugs, which seemed to calm things down. However, over the next few months I was very unwell—one week with tonsillitis, the next with an infection in my testicles, then back to tonsillitis, and so on. I also had bad mouth ulcers that sometimes made eating difficult. All of this was accompanied by flu-like symptoms, whereby my bones ached and I had very little energy.

During the two years when I had repeated infections, I was admitted to hospital nine times. My mouth and genitals were ulcerated and lumps kept appearing. During one of these stays, I was taken for tests and found myself in the genitourinary medicine clinic. They suspected AIDS or something similar, and I was terrified. In my mind, I had gone from being just a nuisance to the doctors to someone who could have a life threatening disease.

My tonsils were removed, but the ulcers and lumps continued unabated. Then I started getting headaches, which were excruciatingly painful—so bad that I was vomiting and couldn't sleep. Six months later I visited the accident and emergency department because of these headaches and underwent a computed tomography scan because of a suspected brain tumour. I was very scared but agreed to have several medical students examine me to try to find an answer. They put me on steroids to calm things down, and I waited nine days as an inpatient to see a professor, who immediately diagnosed Behçet's syndrome.

Receiving the diagnosis gave me an enormous sense of relief because somebody knew what it was. I started going to Bangor Community Hospital, but I never managed to see the same professor again, even though I attended his clinic. I saw a different junior doctor every time so I had to repeat my medical history with each one. I still had many of my symptoms because they kept changing the dose of my steroids to find the right balance. I was becoming depressed. I thought that now they knew what was wrong with me, surely they could make me better and put me back on track—but that didn't seem to be happening. I started wondering if this was what the rest of my life would be like.

I became depressed and started taking antidepressants at the age of 22 when my general practitioner told me that the job I was doing in a carpet warehouse was too physical and was probably making my condition worse. I thought my life had ended—I didn't want to go out and face the world, and eventually I didn't even see the point of getting out of bed in the morning. My fiancée and my family were all that kept me going through this time, and they tried endlessly to encourage and motivate me. They tried to stop me feeling sorry for myself but also helped me through my feelings of embarrassment at having depression. I don't like to think what would have happened without them.

THE CLINICIAN'S PERSPECTIVE

Behçet's syndrome is an autoinflammatory multisystem disease, characterised by recurrent oral and genital ulcers, often with other clinical features such as sight threatening eye disease, rashes, headaches, and disabling fatigue. The syndrome is found more commonly in Mediterranean countries and the Far East, but many patients in the United Kingdom have this condition. It is often diagnosed late in the UK, and after diagnosis it can be challenging to treat.

I have a large cohort of patients with Behçet's syndrome, and Michael's story is all too familiar. All patients have their own unique stories, but a common thread runs through them. The multisystem, variable, and often diffuse nature of Behçet's syndrome can make it difficult to diagnose. Few doctors are aware of this condition, and the index of suspicion for diagnosing it is therefore low (box). The development of genital ulcers is particularly traumatic because they are not caused by infection. These ulcers naturally bring with them all kinds of concerns for the patient (and their family), often with associated recriminations that may only be resolved after attending a genitourinary medicine clinic, where infection is ruled out. This is especially worrying for families of children with the syndrome.

Getting a diagnosis can be a huge relief, but that may just be the start of the journey. After the relief of finally finding a diagnosis, Michael was frustrated at having to repeat his story to many different junior doctors, who had little or no understanding of the disease. The UK Behçet's Syndrome Society, which has access to good information and links to other patients with this condition, was a lifeline to Michael—as it is to many others in his situation. I was pleased to get the chance to see Michael and am delighted that he has benefited from this. Whenever possible, I ensure that my patients with this syndrome can see me, rather than another doctor, and I try to give them enough time to discuss their problems. It often seems that no one else will listen—other doctors tend to shun involvement because of the complexity of the disease. This puts a big demand on my services.

It is especially frustrating to have effective drugs for severe Behçet's syndrome (tumour necrosis factor α inhibitors), yet often have to battle with primary care trusts to secure funding for them. I am pleased that in Michael's case (and so far for all my patients with this disease) persistent, sensible, and appropriate dialogue has enabled him to receive the right drug, which has produced excellent results. It has been a pleasure to see the great change in Michael's condition, but he has—like many other patients with the syndrome—had a long and painful journey to get there.

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This is one of a series of occasional articles by patients about their experiences that offer lessons to doctors. The *BMJ* welcomes contributions to the series. Please contact Peter Lapsley (plapsley@bmj.com) for guidance.

Index of suspicion

A high index of suspicion for Behçet's syndrome should be raised if the patient has two or three manifestations, such as:

- Painful recurrent mouth ulcers and genital ulcers
- Painful recurrent mouth ulcers and an inflamed eye
- Painful recurrent mouth ulcers, genital ulcers, and an inflamed eye
- Painful recurrent mouth ulcers, genital ulcers, and inflamed joints
- Painful recurrent mouth ulcers, genital ulcers, and skin lesions
- Inflamed eye(s) and inflamed joints, and skin lesions
- Inflamed eye(s), thrombophlebitis, and skin lesions
- Painful recurrent mouth ulcers, an inflamed eye, and a positive family history

These are only examples, not definite indications, and many others could be listed. They are situations in which the diagnosis should be suspected and further advice sought

It was one of my family who found the Behçet's Syndrome Society—the UK support group for people with this illness. He printed off all the information they have and eventually I rang the helpline and spoke to someone else with the condition for the first time. This was more helpful than I could have imagined, and to know I was not alone was an incredible source of strength. It was through their quarterly newsletter that I learnt about the Behçet's clinic at University Hospital Aintree, Liverpool, run by Professor Moots. I rang and made an appointment to see him.

The treatment I received was very different from that I had received in Bangor. Professor Moots understood the illness, as did all the nurses, and they all took an interest in me. I tried several different drugs including azathioprine, which caused chest pains and breathing difficulties. In January 2006, I was started on tacrolimus, but this triggered an epileptic fit and had devastating effects on my personal life. At that time I had a good job as a financial adviser in a building society and had learnt to drive during the previous year. Suddenly my independence was taken away because I could no longer drive and had to rely on others for lifts.

What worked and what didn't work for me

What has worked well

Attending the specialist clinic at Liverpool where the staff understood my condition and took an interest in my whole wellbeing

Infliximab has been life changing and has given me back a "normal" life free from constant headaches, lumps, ulcers, and fatigue—I can now enjoy life

The support I received from my fiancée, my family, and the Behçet's Syndrome Society. Knowing I wasn't on my own and having people I could rely on made all the difference

What didn't work so well

Having to change jobs twice because of my condition—once because the work was too physical and then because I had too much responsibility and couldn't take time off work for medical reasons

Waiting so long for a diagnosis. This led to depression and the lowest point of my life

Behçet's syndrome is rare, and many doctors do not know about it or understand it. They can be very patronising and don't realise that patients with an illness of this kind have to read up about it and may even know more than they do about the condition

USEFUL RESOURCES FOR PATIENTS AND HEALTHCARE PROFESSIONALS

Behçet's Syndrome Society (www.behcets.org.uk)—This organisation has a medical panel of UK experts, provides information and support over the phone or by email, and offers a web chat forum

Arthritis Research Campaign (www.arc.org.uk)—Provides an information leaflet on Behçet's syndrome.

International Society for Behçet's Disease (www.behcet.ws)—A multidisciplinary medical group with a focus on research into Behçet's syndrome

American Behçet's Disease Association (www.behcets.com)—Provides web, email, and chat forum facilities

Patient support groups exist in Belgium (www.membres.lycos.fr/behcet/kbsrch.htm), Germany (www.behcet.de), Israel (www.behcet.org.il); Italy (www.behcet.it), Japan (www5f.biglobe.ne.jp/~behcet/index.html), Korea (www.behcet.co.kr), Portugal (www.behcetportugal.com.sapo.pt), Spain (http://es.groups.yahoo.com/group/Behcet-Enfermedad), and Turkey (www.hulusibehcet.net/society.htm)

Later that same year, on holiday in Turkey with my fiancée, I had another fit. I was taken to intensive care where they suggested I needed a further computed tomography scan. I signed myself out thinking it would be best to do this back in the United Kingdom, but this was a very expensive hospital trip both in financial terms and in the way that it undermined my confidence and my fiancée's. On my return home, I phoned the local hospital for an appointment and was told it would be six months before I could see a neurologist. Again, I used the services of the Behçet's Syndrome Society and arranged a private appointment with a neurologist who specialises in Behçet's syndrome in London—Dr Kidd. He diagnosed the epilepsy and gave me suitable treatment, which has meant that I haven't had another incident, and in May 2007 I regained my driving licence.

It was obvious that tacrolimus wasn't the right drug for me, so I tried two further drugs, which unfortunately did not improve my ever present symptoms. In June 2007, I became really ill—I was planning to get married a couple of months afterwards and wanted to be well and enjoy our big day. I was admitted to hospital by Professor Moots and given infliximab, which has changed my life and my outlook. When I was ill before, I would always blame the Behçet's syndrome, but now I don't just assume this because I generally feel so well. My symptoms are under control and my outlook is much more positive.

Where I am now?

With the help of my consultant and my family, I am now happily married with a job I enjoy. We would like to start a family but need medical advice about this. I feel much better and don't go to bed dreading what tomorrow will bring or wondering if we dare go abroad again without a chaperone. My worry is what will happen if infliximab stops working, but I hope there will be alternatives by then.

Contributors: MH wrote the main text of the article, and RJM wrote the clinician's perspective box.

Competing interests: None declared.

Provenance and peer review: Commissioned; not externally peer reviewed.

LESSON OF THE WEEK

Reduced level of consciousness from baclofen in people with low kidney function

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Cite this as: *BMJ* 2009;339:b4559
doi: 10.1136/bmj.b4559

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Baclofen may lead to reversible neurological changes and coma in people with low kidney function

Baclofen is commonly used to treat spasticity,[1] dysfunctional voiding, intractable hiccups,[2] palatal myoclonus, trigeminal neuralgia, and addiction to opiates, alcohol, or cocaine.[3] Accumulation in people with low kidney function leads to neurological deterioration and coma. This problem occurred in four patients at our hospital within a year. We report a typical case and systematically review the literature.

Case report

A 61 year old woman with end stage renal disease who was receiving haemodialysis was admitted with *Staphylococcus epidermidis* discitis; vancomycin and narcotic analgesics were started. She had a history of hypertension, diabetes, and calciphylaxis. In her fourth week in hospital, oral baclofen 5 mg three times daily was prescribed for back pain and muscle spasms. Within 12 hours she became disoriented, and by 36 hours had deteriorated to a Glasgow coma score of 8. Her other drugs (hydromorphone 5 mg subcutaneously every four hours, pregabalin 50 mg daily, amitriptyline 10 mg at night, lorazepam 1 mg at night, irbesartan, repaglinide, and vancomycin) had not changed. Blood pressure was 140/75, temperature 37.0ºC, heart rate 70 beats/minute, and oxygen saturation 99% on room air. There were no focal neurological deficits. The remainder of the examination was consistent with known problems. Full blood count, electrolytes, and concentrations of glucose, calcium, phosphorus, and magnesium were similar to her previous values and in keeping with her end stage renal disease.

She had received 15 mg of baclofen in total. Baclofen toxicity was diagnosed, baclofen was stopped, and 12 hours after the last dose, she underwent a four hour haemodialysis treatment. Mental status improved, and after a second four hour treatment on the next day, she was her usual self.

Between April 2007 and February 2008, we recognised central nervous system depression from baclofen in three other people with kidney failure at our hospital: one patient who was receiving peritoneal dialysis, one who was receiving haemodialysis, and one with non-oliguric acute kidney injury (creatinine 423 µmol/l) who had not required dialysis. Two patients were treated with haemodialysis and recovered completely after one or two sessions. The remaining patient continued her usual peritoneal dialysis regimen: her time to recovery was longer than for the other affected patients.

Discussion

Our literature search found 18 reports of 33 people with baclofen toxicity in the context of low kidney function in the English language literature and an additional three reports of six cases described in English abstracts of publications in other languages.[w1-w21] We summarised the case histories in a table (see bmj.com).

Discussion

Baclofen, a γ-aminobutyric acid analogue, interferes with the release of excitatory neurotransmitters and inhibits monosynaptic and polysynaptic transmission at the spinal cord level. An oral dose is rapidly (0.5-3 hours) and almost completely absorbed from the gastrointestinal tract,[4] and the drug crosses the blood-brain barrier. Cerebrospinal fluid concentrations of about 12% of plasma concentrations have been reported. About 70-80% is excreted in the urine unchanged. In patients with normal kidney function, the plasma and cerebrospinal fluid elimination half lives are 3-4 hours and 1-5 hours, respectively.[5 6]

In patients receiving dialysis, exposure to as little as 5 mg baclofen daily or a cumulative dose of 15 mg may cause toxicity.[7 8] In patients with chronically low kidney function, not requiring dialysis (creatinine 300-495 µmol/l, glomerular filtration rate likely <20 ml/min), toxicity may develop after ingesting as little as 25 mg of baclofen.[8] In people with chronic kidney disease who have been given baclofen at usual doses, toxicity has not been reported unless serum creatinine exceeds 300 µmol/l. In people with acute kidney injury, toxicity has been reported with serum creatinine as low as 159 µmol/l (in a patient with urinary retention who became hypersomnolent four days after an increase in dose from 30 mg/day to 45 mg/day).[9]

The most common manifestation of baclofen toxicity is change in level of consciousness, often within 12 hours of exposure. Other less common findings are hypotonia, hypotension, bradycardia, abdominal pain, nausea, and vomiting. Symptoms resolve when baclofen is stopped; in many cases haemodialysis has also been used. Recovery takes three to nine days in people who are not treated with haemodialysis,[4 8 10] but occurs during or within a few hours after haemodialysis. However, more than one dialysis treatment is often necessary for complete resolution.

Low protein binding (31%) and low volume of distribution (2.4 l/kg) lead to efficient removal of baclofen by dialysis.[5 11] Half life during haemodialysis was 3.7 hours in one report,[12] and improvement in mental status was shown to parallel the fall in serum concentration.[12] Delayed diffusion across the blood-brain barrier is thought to account for the lag of a few hours in clinical recovery seen in some people.[12]

The severity of toxicity in people with low kidney function is not highlighted in the product monograph or drug references. The product monographs states: "Impaired renal function. Because Lioresal [baclofen] is primarily excreted through the kidneys, it may be necessary to reduce the dosage. Signs

and symptoms of overdosage have been reported with doses above 5 mg in this setting."[1] The *British National Formulary* recommends using smaller doses (5 mg daily) in people with glomerular filtration rate between 20 and 50 ml/min), but it does not provide specific recommendations for use in people with kidney function lower than this.[13] The *Canadian Compendium of Pharmaceuticals and Specialties* states that baclofen should be used with caution in patients with kidney failure.[14] The American College of Physicians' guidance on prescribing in renal failure contains no information on baclofen.[15] None of these widely used references provides a clear recommendation about safety in people with glomerular filtration rate less than 20 ml/min, nor do they state a level of kidney function below which the drug should not be given.

Our case highlights the importance of considering kidney function when prescribing baclofen. People treated with baclofen for spasticity may also have neurogenic bladder, a risk for low kidney function, or low muscle mass that leads to serum creatinine concentrations being overestimates of kidney function. In people with glomerular filtration rate between 30 and 60 ml/min/1.73 m^2 (stage 3 chronic kidney disease), we recommend starting with very low doses at long intervals and titrating to effect. In people with glomerular filtration rate <30 ml/min/1.73 m^2 who have muscle spasms or cramps, we recommend using alternative drugs (tizanidine, dantrolene, or diazepam) with dose adjustments, and checking for interactions with other drugs. Haemodialysis is useful in managing symptoms of people with baclofen intoxication from any cause, but may need to be repeated.

Contributors: All authors recognised the importance of the problem and decided to disseminate information on it. WS performed the literature search and wrote the manuscript; CMC, EJFC, and CY contributed to the intellectual content of the manuscript in subsequent drafts. WS is guarantor.

Funding: None.

Competing interests: None declared.

Provenance and peer review: Not commissioned; externally peer reviewed.

Patient consent obtained.

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Accepted: 5 July 2009

10-MINUTE CONSULTATION

Pollen food syndrome in a teenage student

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Cite this as: *BMJ* 2010;340:b3405
doi: 10.1136/bmj.b3405

This is part of a series of occasional articles on common problems in primary care. The BMJ welcomes contributions from GPs

A first year university student comes to see you with a history of itching and mild lip swelling after eating apples and pears. She has also noticed tingling in her mouth after eating nuts.

What issues you should cover

Detailed history is the cornerstone of diagnosis

Pollen food syndrome (also known as oral allergy syndrome) comprises a set of symptoms usually involving itching and mild swelling—typically limited to the oropharynx—after eating raw fruits, vegetables, peanuts, nuts, and sometimes spices (box). The range of symptoms can be wide and may include anaphylaxis, although this is uncommon. The symptoms are due to an immediate (IgE mediated type 1) hypersensitivity reaction typically caused by cross-reactivity between the protein found in these foods and those in pollens. Symptoms are therefore predictable, beginning within minutes of exposure. Affected people are able to tolerate these foods when cooked because the allergen responsible is heat labile.

Foods commonly implicated in pollen food syndrome[1]

Birch—fruits: apple, apricot, cherry, kiwi, nectarine, pear, peach, plum, prune, and quince; nuts: almond, hazelnut, and walnut; vegetables: carrot, celery, and potato

Grass—fruits: melon, orange, watermelon; peanuts; vegetables: potato, swiss chard, and tomato

Plane—fruits: peach, apple, melon, and kiwi; legumes: chickpea, green beans, peanut; vegetables: lettuce

Ragweed—fruits: banana, melon and watermelon; vegetables: courgette and cucumber

How does the problem affect her?

Ascertain whether she has any respiratory or systemic manifestations, which would indicate an anaphylaxis type picture; such reactions are rare. Ask her to describe her worst ever reaction.

Ask about related comorbidities, particularly hay fever and asthma

Spring hay fever (triggered by pollen from trees and, to a lesser extent, grass) and asthma commonly coexist with

USEFUL FURTHER READING AND RESOURCES FOR PROFESSIONALS AND PARENTS

Further reading

Holgate ST, Church M, Lichtenstein LM. *Allergy.* 3rd ed. Mosby Elsevier, 2006

Mari A, Ballmer-Weber BK, Vieths S. The oral allergy syndrome: improved diagnostic and treatment methods. *Curr Opin Allergy Clin Immunol* 2005;5:267-73

Pumphrey R. Anaphylaxis: can we tell who is at risk of a fatal reaction? *Curr Opin Allergy Clin Immunol* 2004;4:285-290

Sampson HA, Mendelson L, Rosen JP. Fatal and near-fatal anaphylactic reactions to food in children and adolescents. *N Engl J Med* 1992;327:380-4

Vieths S, Scheurer S, Ballmer-Weber B. Current understanding of cross-reactivity of food allergens and pollen. *Ann N Y Acad Sci* 2002;964:47-68

Resources for healthcare professionals and patients

Allergy UK. Oral allergy syndrome. http://www.hayfeverexpert.co.uk/OralAllergySyndrome.html

British Society for Allergy & Clinical Immunology. Oral allergy syndrome. http://www.dr-hyer.co.uk/resources/BSACI_Oral_Allergy$5B1$5D.pdf

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pollen food syndrome. Asthma is particularly important because, if poorly controlled, it greatly increases the risks of fatal reactions to foods.

What treatments, if any, has she tried and with what effect?

Also ask about treatments for hay fever and asthma, if relevant, and her compliance with these. Emerging evidence suggests that optimal management of allergic rhinitis improves the control of asthma.

What you should do

Examination

Inspect the upper airways for signs of rhinitis and examine the chest for signs indicating asthma. Take her peak expiratory flow, but remember that a single normal peak expiratory flow does not exclude a diagnosis of asthma. Consider lung function testing if the diagnosis of asthma is in doubt.

Confirmatory testing

The history will usually be sufficient to secure the diagnosis, but a serum specific IgE to the foods in question may confirm it. Alternatively, a clinician trained in skin prick testing may undertake a prick-prick test using the raw unpeeled foods; commercially prepared allergen solutions sometimes lack the full complement of relevant allergens and are potentially misleading. There is, however, a very small risk of these prick tests triggering a systemic allergic reaction, so adrenaline and a member of staff trained in its administration and resuscitation should be available.

Food avoidance

All raw fruits and vegetables that cause symptoms should be avoided. Cooked and processed foods can be safely consumed if they do not result in symptoms.

Advice on botanical relations

Although some advocate precautionary avoidance of all fruits and vegetables in the same family (for example, plums, peaches, prunes, apricots, and nectarines in those with plum allergy)—even those that have not caused symptoms—this is seldom necessary in practice. If the patient is concerned, suggest that he or she tries the mucosal touch test in the doctor's presence: this involves rubbing the food first on the outside and then inside of the lip, and then, if it is tolerated, taking a bite and chewing well before spitting it out. This test is not recommended in those with a history of anaphylaxis.

Treatments

In most people symptoms will resolve spontaneously over a matter of minutes to a few hours, but rinsing the mouth with water can help speed up elimination of the allergen from the mouth and reduce symptoms; antihistamines can be taken if necessary. Avoid use of sedating antihistamines. Those with features of anaphylaxis (symptoms suggesting respiratory or cardiovascular involvement) should be given an adrenaline autoinjector and trained in its use. Take the opportunity to optimise treatment for hay fever or asthma. Desensitisation therapy varies in effectiveness and is not recommended.

Information and support

Reassure her that in most people symptoms are mild, but that there may be an exacerbation during the hay fever season. Patient support materials such as those listed in Useful further reading and resources may be helpful.

We thank Drs Sangeeta Dhami, Richard Hills, Hilary Pinnock, and Karena Platts for their helpful comments on an earlier draft of this manuscript. Our thanks also to the peer reviewers for their constructive feedback.

Contributors: AS conceived this paper. Both authors contributed to writing the paper and are joint guarantors.

Conflict of interests: None declared.

Provenance and peer review: Not commissioned, externally peer reviewed.

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Accepted: 5 August 2009

The F word

When I was working in a hospital admission unit in Canada, the ward manager called me into her office with a grim face and said "I'm afraid I have had an official complaint about your conduct." She explained that "three separate nurses have complained that last week you used the 'F word' to a patient's face"

I was amazed and horrified—and repentant. "Well, I have no memory of it, but I can't argue with three separate complaints. All I can say is I'm very sorry, and will make sure it doesn't happen again."

She was very relieved. "Oh good. I can close the file. In future you may use words like 'obese,' or 'overweight.'" I am proud that I managed to get out of her office with a straight face.

Incidentally, 60% of the Canadian population are now obese or overweight.

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Competing interests: None declared

Cite this as: *BMJ* 2010;340:c618