

Antibiotics: "Take these just in case"

DR DANIEL FLYNN explains how prescribing antibiotics when they're not truly necessary can potentially create dangerous, unintended consequences...

ANTIBIOTICS are, without a doubt, the miracle drugs of the 20th and 21st Century. On reflection, it is a testament to human ingenuity, curiosity and endeavor that such effective drugs are available for our patients.

These "magic bullets" can be selected to target pathogenic bacteria without damaging human cells. The effectiveness of such drugs is truly remarkable and has resulted in countless millions of lives being saved. Prior to this pharmaceutical revolution, infections were treated surgically or with substances from folklore and myth.

The great Alexander Fleming is credited with discovering penicillin. Like a lot of great discoveries, it occurred by accident. Fleming had left a petri dish, containing *Staphylococcus* species, open overnight. The following morning it was found to be contaminated by a mould.

The interesting finding was that the mould had caused an inhibition of growth of the bacterial cells directly around it. When the mould was isolated, it was found to be the fungus, *Penicillium*. But, he was not the first to notice this phenomenon. In fact, thousands of years ago, in ancient Greek and Indian societies, moulds and other plants were used to treat infections. Since the active substrate of the mould – penicillin – was isolated, the drug has been placed in mass production.

Penicillin was incredibly effective at treating infections during the Second World War, during which it saved countless lives, not to mention all the limbs that would otherwise have been amputated. It had a high excretion rate and was so prized at the time that urine was collected so that the penicillin could be recycled and reused.

Antibiotics and dentistry

However, misuse of the drug over time has contributed to the development of resistant strains of bacteria forming. Frighteningly, there are now organisms that are resistant to all approved antibiotics and can only be treated by experimental antimicrobials, which may potentially be extremely toxic.

Antibiotics should be given the respect they deserve, otherwise infections which were amenable to treatment by antibiotics may become untreatable. We all have a duty as clinicians to only prescribe antibiotics when they are truly indicated. Prescribing antibiotics instead of initiating treatment on "difficult" patients or due to time constraints should be minimised to exceptional situations.

Patients have now grown accustomed to taking antibiotics following treatment or, in some cases, instead of treatment, and will often pressurise a clinician into prescribing an antibiotic. As clinicians, we feel better when we prescribe the drugs as it seems we are doing everything in our power to assist the patient and prevent future problems. These noble intentions have very serious, unintended consequences.

In an ideal world, antibiotics should have a very minor role in modern day dentistry. We are all acutely aware that everyday practice can be challenging to manage, especially if there are numerous emergency appointments added to a full-day list. In specialist

practice, there is more time to assess and treat patients, and, as a result, it is extremely rare to prescribe an antibiotic.

In the last year, we wrote two scripts for antibiotics, which is certainly much less than what I used to prescribe when I worked in general practice, but this is also due to a better understanding of the biological interactions of odontogenic infections and pain.

Amoxicillin and metronidazole

The antibiotics predominantly prescribed by dentists are amoxicillin and metronidazole. Penicillin (amoxicillin) works by inhibiting the final transpeptidation reaction necessary for the formation of a rigid bacterial cell wall. This means the cell must be dividing for the antibiotics to work and results in a cell that has a porous cell wall and that ultimately dies. Importantly, human cells do not have cell walls and therefore are completely unaffected by this process.

Amoxicillin is used as it is resistant to gastric acid and can achieve a higher serum concentration than other penicillins. Some bacteria are capable of degrading the β -lactamase structure of the antibiotic, and, therefore, clavulanic acid can be added to amoxicillin to increase the bacteria that is susceptible to the antibiotic. The acid works as a "suicide inhibitor" by binding irreversibly and competitively to the bacterial enzymes that break down the antibiotic.

Metronidazole is an antibiotic used primarily for anaerobic infections. It diffuses into these cells and is subsequently reduced into the active metabolite. This is then incorporated into the DNA and disrupts the helical structure. This inhibits nucleic acid synthesis, resulting in cell death. The reason metronidazole is not toxic to human or aerobic cells is because the drug is not reduced into the active metabolite in these cells.

Demeclocycline is present in Ledermix. It acts as a bacteriostatic agent and therefore does not kill bacteria. Like metronidazole, it diffuses into the cell and inhibits cell growth by inhibiting translation (protein synthesis).

I only use Ledermix in trauma cases or in cases where there is a hot pulp. Ledermix is used as an interappointment dressing to decrease the chances of external resorption in trauma cases¹ and to decrease the inflammation in the pulp in "hot pulp" cases. It is the steroid rather than the antibiotic that is effective in both these cases.

Studies have shown that 70 per cent of the steroid is released in the first 24 hours, with the remainder released over the following days.² Ledermix, contrary to popular belief, does not reduce the risk of flare-up following first stage RCT. However, it may reduce the post-operative pain in cases of acute apical periodontitis.³

Endodontic procedures

In conjunction with endodontic therapy, in order to alleviate dental pain, several surveys have shown a tendency among dentists to prescribe antibiotics. Despite advances in our understanding of the causes of pain and the risks associated with the prescription of antibiotics, there is still an alarming amount of prescriptions "just in case".

Although this is done for all the right reasons, we must seriously question ourselves

every time we reach for the prescription pad, and wonder if it is in the patient's (and society's) best interests, or whether we are doing this to make everyone feel good.

Antibiotic resistance

Antibiotics tend to be misused in three major ways.

1. They are used for too long a duration.
2. When used as a substitute for definitive treatment i.e. incision and drainage, root canal treatment or extraction.
3. When used prophylactically or "just in case". When you hear yourself uttering these three words put your pen down, or at least instruct the patient not to get the drugs unless there is a problem, and they have taken appropriate analgesics and consulted with you on the telephone.

There is no need to continue taking antibiotics for seven to 10 days if after three to five days all symptoms have disappeared. Remember, it has been estimated that there are 10 times the number of bacterial cells in our bodies than human cells. All of these cells are exposed to the antibiotic despite the vast majority of the bacterial cells providing a protective function in our system.

When antibiotic resistance develops, it may be passed on to other species of bacteria and these species can then, in turn, be passed on to other people. Bacteria have proven to be incredibly successful at adapting to all environments and have acquired ingenious ways of developing resistance to antibiotics:

- They can produce substances that inactivate or breakdown the antibiotic e.g. β -lactamase enzymes which inhibit penicillin.
- Pump the antibiotic out of the cell.
- Alter the structure of the antibiotic target site.
- Alter their metabolic pathway and find another way of making the essential material that the antibiotic inhibits.

Treating pulpitis and abscesses

Antibiotics are frequently prescribed to patients presenting with pulpitis. If a patient has a vital pulp or gives a history consistent with pulpitis, then do not prescribe antibiotics. Pulpitis may be reversible or irreversible. The cause of the pain is an inflammatory response within the pulp chamber. In summary, the inflammatory response is initiated by microbial irritation, chemical, thermal or mechanical trauma. The inflammatory mediators (such as substance p, cytokines and bradykinin) that are released, cause nerve sprouting and decrease the threshold that needs to be reached for the nerve to fire.

This explains why a cold or hot stimulus causes pain in an inflamed tooth and not in a healthy pulp. The analogy is that the pulp, just like sunburned skin, is extremely sensitive to touch, whereas healthy skin reacts normally to these stimuli.

Antibiotics are not appropriate to treat pulpitis. If irreversible pulpitis is diagnosed, then a pulpotomy will reduce 90 per cent of the symptoms and allow analgesics to be more effective. If you decide to enter the canals following a pulpotomy, it is better to fully chemomechanically debride the whole canal system, rather than partially removing part of the pulp tissue within the canals.

About the author

Dr Daniel Flynn qualified from the Dublin Dental Hospital, Trinity College in 2002. Dr Flynn has recently joined the EndoCare team, headed by Dr Michael Sultan. He lectures and provides hands-on courses for general practitioners. He also teaches endodontics at the Eastman Dental Institute for Oral Healthcare Sciences.



Definite treatment is the gold standard.

However, in emergencies where it is not possible to initiate treatment, analgesics and anti-inflammatories are the treatment of choice. I would prescribe 400mg of ibuprofen (max dose 3200mg/day) and 500mg paracetamol (max 4,000mg/day) to be taken every four to six hours, and plan to start treatment at the first available opportunity.

In necrotic cases and cases with periradicular abscesses, once definitive treatment (root canal debridement or extraction) has been completed, then antibiotics are not necessary. Studies from our oral surgery colleagues show that antibiotics can reach the pulp space in a matter of hours in vital teeth, however, in necrotic pulps, it takes days to be detected.

As there is no blood supply, the antibiotics presumably diffuse into the empty space. The source of infection in apical periodontitis is almost always a bacterial biofilm that is present within the root canal system. Antibiotics will have little effect on this biofilm. In acute cases, bacteria may leave the root canal system and can be found in the periapical tissues. Again, if the source of infection is removed by extraction or root canal treatment, then the immune system will adequately deal with the remaining bacteria. In cases where there is a draining sinus present, antibiotics should not be prescribed in lieu of treatment. If a sinus is present, then it is unlikely that there will be significant pain following treatment. But, some patients may notice an increase in discharge in the days immediately following treatment.

Spread of infection

One of the few legitimate reasons for using an antibiotic in endodontics is if there is a spreading infection and there is systemic involvement. The basic measures of removing the source is essential, however, in this scenario, the bacteria are distant to the source of infection and continue to spread.

These bacteria are virulent enough to invade and thrive in tissues and may cause significant morbidity, or, in extreme situations, even mortality. Systemic involvement is indicated by extra-oral swelling, fever, malaise and lymphadenopathy.

Patients with systemic involvement may be managed by a general dentist or a specialist endodontist, but severe cases may need to be referred to an oral surgeon or a maxillofacial surgeon for extensive drainage and hospitalisation. In this instance, empirical antibiotics are prescribed before culture and sensitivity tests are carried out to ascertain what antibiotics are the most effective to control the infection. ■

References

1. A. Pierce and S. Lindskog, *The effect of an antibiotic/corticosteroid paste on inflammatory root resorption in vivo*, *Oral Surg Oral Med Oral Pathol* 64 (1987), pp. 216–220.
2. Hume W.R., Testa Kenney A.E. *Release of 3H-triamcinolone from Ledermix (1981) Journal of Endodontics*, 7 (11), pp. 509–514.
3. E.H. Ehrmann, H.H. Messer and G.G. Adams, *The relationship of intracanal medications to postoperative pain in endodontics*, *Int Endod J* 36 (2003), pp. 868–875.