Systemic Management of Infection: Antibiotics (AOT Lecture #14)

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Before we get started, I have a few disclosures. I am a paid consultant for Alcon Pharmaceuticals, Carl Zeiss Meditec, and Inspire Pharmaceuticals.

Today's lecture is going to talk about systemic antibiotics. I think this is an important lecture, particularly for optometrists who are out there right now. We own the anterior segment – this is our area, and we can use topical antibiotics really, really well. However, we get hesitant when we start talking about systemic antibiotics. We just hesitate to write a prescription, and I don't think we should. There are certain conditions that call for a systemic antibiotic, and what I'm going to cover in this lecture is the different groups of antibiotics. You're going to find that I cover those same conditions for each of the different groups, and you might say, "Well, I'm just going to use this one," and that might initially be more convenient, but you have to remember that patients are allergic to antibiotics, or there might be a cost issue. So yes, you might just give 1 gram of azithromycin to a patient who has a chlamydial or gonorrheal infection, but they might not be able to afford that, or they are allergic to azithromycin. In that case, we could use doxycycline, instead. Thus, I will go through a bunch of different conditions. There may be more than one way to do this, but I'm going to cover each of the different groups.

I will ask questions during the presentation, and I'd like you to think about how you would answer them, before scrolling down the pdf and seeing the correct response.

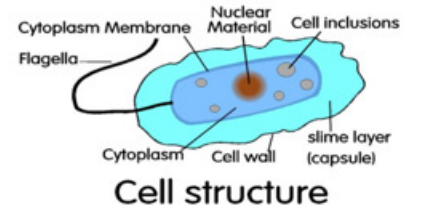
Here is our first question:

1. Antibiotics utilize differences between bacteria and human cells in order to produce their effects. Which of the following is a characteristic difference between human and bacterial cells?
    a. The ribosomes have different subunits
    b. Humans have cell walls
    c. Bacteria use human cells to replicate further copies of themselves
    d. Human cells are made up of sugar and spice, and everything nice

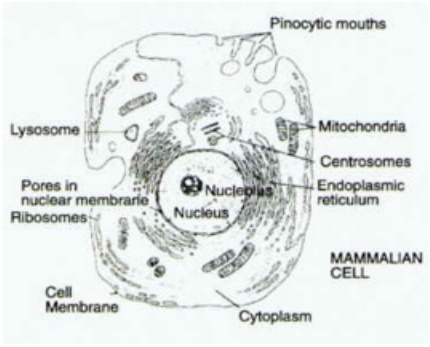
Scroll down to the next page to see the correct answer.

We want antibiotics to work on the bacterial cells, and not the human's. Thus, the correct answer is a.

Figure 1: (Top) Bacterial cell structure. (Bottom) Mammalian cell structure.



Cell structure



Humans don't have cell walls – bacteria do. There are certain groups of antibiotics – the penicillin group – that work specifically on cell walls. If the antibiotic breaks down that cell wall or doesn't allow it to form, it doesn't affect the human cells. That is our penicillin group. Penicillins are actually very gentle on our system, because we do not have cell walls.

Ribosomes do have different subunits than we do, and we do have drugs that will work on that specific part of the cell and it doesn't affect us. Again, this is much gentler on our system. An example of this would be azithromycin. Azithromycin is a very gentle antibiotic – so gentle, in fact, that it no longer works on anything. At this point, staphylococcus is completely resistant to azithromycin.

For antimicrobial therapy, we want to try to target that part of the bacterial cell that is not in common with the human cell, thus lowering toxicity. Bacterial cell walls and bacterial ribosomes are two great options. (See Fig 1)

Table 1: Principles of Antimicrobial Therapy

Selection of an appropriate antimicrobial requires:
Identification of the organism
Its Susceptibility
Site of Infection
Patient Factors
Safety of Agent
Cost of Therapy

When we are looking at microbial therapy, we want to look at different things. (Table 1) One of the things we need to identify is what type of organism is there? We can culture that. A lot of times, however, we will treat first based off of empirical knowledge. This means that we treat based on what is most commonly present in the affected tissue. If, for example, you have a corneal ulcer and you assume it is staph or strep, and it doesn't get better, typically we will culture it at that point to find out what bug is there. But we do treat empirically.

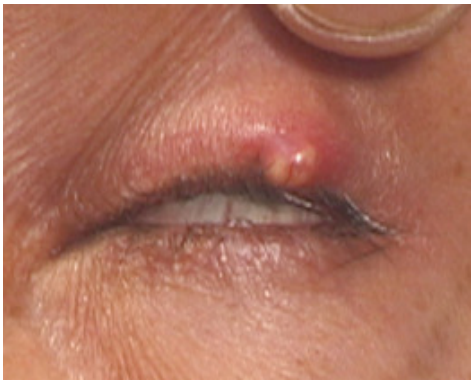
We also want to know its susceptibility – again, if the infection is not getting better, we will usually do staining or culture a sample so we can find out what antibiotics the bacteria is susceptible to.

The site of infection – we know that if you want to treat an ocular infection, the best way to do that is with a topical drop. You get a higher concentration of medication in the eye if you use a drop rather than trying to go the oral route. Unfortunately in things like the vitreous, you're not going to get mediation from a topical drop in there, so a lot of times our choices are either injections or via the systemic route.

Something that we don't typically think about is cost of therapy. We are happy to write prescriptions, but don't always stop to think about what the cost will be to the patient. A great example of that is our prostaglandin analogs for glaucoma. These are very expensive medications. Yes, they are our first line of therapy, but if your patient cannot afford it, then you prescribing it does not really help the patient. We don't usually consider pilocarpine for glaucoma treatment, anymore, but you can get 10 gallons of it

for $1.00! If that's the only thing the patient can afford, then you need to make sure that you take that into consideration.

Our next question concerns empirical treatment:



2. What is the most likely causative agent for the condition pictured to the right?
    a. Pseudomonas
    b. Staphylococcus
    c. Streptococcus
    d. Haemophilus

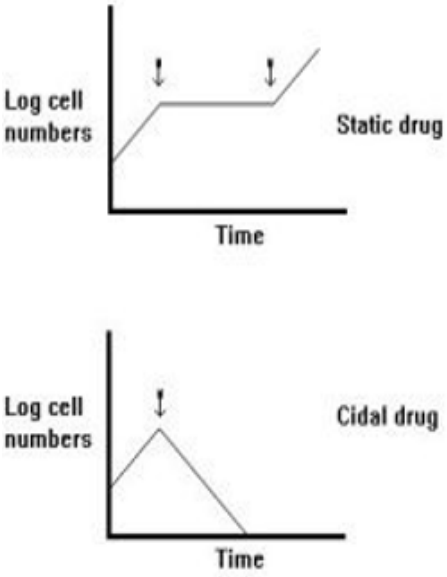
Scroll down for the answer when you are ready.

The correct answer, again, is b. Staphylococcus is the most common bacteria that is on the lids. Pseudomonas, chosen by one attendee when this lecture was originally recorded, would be of particular concern to me in a contact lens patient. Why? Because pseudomonas really likes contact lenses.

Let me tell you a scary story about pseudomonas: What do we know about pseudomonas if it gets a foothold on the cornea? It can perforate an intact cornea within 24 hours. I had a patient who was about 80 years old, who came in Monday morning. I'd actually seen him a week before as a low vision patient. That Monday morning we were very busy, so I told the intern to go take a look at him. The

intern came back and said, “I think he’s got a pre-septal cellulitis.” I asked why the intern thought that, and they said, “Well, his eye is really inflamed and swollen, he won’t open his eye.” Obviously, we needed to get a look at the eye, so when we opened it up, pus just started oozing out of his eye. We lavaged, and even more pus oozed out. The eye was completely opaque. We started dumping on antibiotic, and sent him to a corneal specialist. The patient perforated the next day, developed endophthalmitis and had that eye removed two days later. They cultured the infection as pseudomonas. Now, this patient was not a contact lens patient, but he was a severe dry eye patient. Again, the SPK that stains in dry eye, that is not normal. The ocular surface is very good at taking care of itself – it doesn’t allow bacteria to get a foothold on it because it keeps a nice, smooth surface. By definition, contact lenses are on your eye, and they cause a roughening up of the surface. If pseudomonas gets a foothold on the cornea, it will go through an intact cornea within 24 hours. Thus, if you have a contact lens patient with a red eye, they need to come in and see you. That’s why we get so concerned when the economy slumps, patients are now extending the use of their contact lenses – they are using a 2 week lens and wearing it for 9 months, for example. We need to be particularly careful with our contact lens patients, due in most part to pseudomonas.

Figure 2: (Top) Effects of a bacteriostatic drug on a population of bacteria. (Bottom) Effects of a bactericidal drug on a population of bacteria.



If you were dealing with Haemophilus, what group would most likely be affected? What demographic of patient is typically affected? Children – usually under the age of 8. If you have someone over the age of 8, it is not Haemophilus anymore. Haemophilus is a big one for kids.

When we look at different properties of antimicrobials, we have two different forms of antimicrobial agents. (Fig 2) We have ones that are bactericidal. They kill every bug that is in our system. We also have bacteriostatic agents. Bacteriostatic agents stop the bacteria from replicating. But, whatever bugs are already there, the drug will not take care of those, so you need an intact immune system. Thus, you would not want to give a bacteriostatic agent to someone who has, say, AIDS or is going through chemotherapy, because they have a compromised immune system at that point. In that case, we would want to make sure to use a bactericidal agent, because that will kill all bugs present. Bacteriostatic agents only prevent bacterial replication – an intact immune system needs to take care of any infection that is already there.

Other things that we need to look at: we need to make sure we get adequate levels of the antimicrobial agent to the affected tissue. Again, if you’re talking about the front surface, you are usually looking at using a topical drop because that’s the best way to get the highest concentration of antibiotic to the target area. Oral medications are usually not great for the anterior surface of the eye. Remember also that natural barriers to drug delivery exist in different parts of the body, including the prostate, CNS, brain and vitreous.

Additional patient factors that you want to pay attention to include the status of the patient's immune system, their kidney and liver function, age, gender, breastfeeding, pregnancy, allergies – all of these play a role when you are deciding what type of antimicrobial medications you want to use.

Again, make sure your patient has an intact immune system. Patients who are alcoholic, diabetic, HIV/AIDS, going through chemotherapy, etc. – these are the patients you do not want to be using bacteriostatic agents on.

We have some antibiotics that are minimally toxic. These are like your penicillin group. Because they act on a certain part of the bacterial cell that we don't have, they are not really toxic to our system. Now remember, when we are talking about toxicity, we particularly are talking about side effects, or allergies. Patients will say, "I'm allergic to penicillin." If you get GI upset from it, that does not mean you are allergic to it. That is a common side effect to all antimicrobial agents – they are not just going to specifically attack one bug in your GI system, and you need a certain number of normal bacteria in your GI system to have a normal system. So, nausea, diarrhea, GI upset, that is <u>not</u> an allergy. That is just a side effect. Allergies tend to give us flushing of skin and breathing problems.

We also have antimicrobials that are very toxic to our system, and they are usually reserved for life-threatening conditions. For example, chloramphenicol is an amazing antibiotic – it kills everything, including the patient. What is the major complication to chloramphenicol? Aplastic anemia! It can happen even 6 months after the patient has stopped taking the medication, and patients have actually died from taking it as a topical drop. Interestingly enough, for our colleagues in the U.K., the only antimicrobial agent that they have is chloramphenicol. It's a great antibiotic, and patients don't typically die from it, but in the U.K. they don't have access to fluoroquinolones, but they do have chloramphenicol. I find that a little bit interesting.

Remember the cost of therapy. Here's a question for you.

3. Just thinking of these, and I'm not talking about generics or if insurance will cover it, and so-on, based solely on cost of the drug, which of the following would be the most economical for you to prescribe for a patient?
    a. Augmentin 500 mg
    b. Doxycycline 50 mg
    c. Azithromycin (Z-pak)
    d. Keflex 500 mg

Scroll down to the next page when you have chosen your answer.

Here, the correct answer is b – Doxycycline. Augmentin is a great antibiotic, and we will talk a lot about it. It is one of my favorite antibiotics, and has great soft tissue penetration. However, Augmentin, without the generic, for 30 pills can cost about $150-$160 to get. Azithromycin (Z-pak) is available as a generic form now, which is great, but the great thing about a Z-pak is that dosing is amazing. It's two pills for the first day, then one pill for the next four. But the patient pays for that convenience – about $150 if you don't have any insurance and you get the brand name. Keflex also has really good soft tissue penetration, but it is probably the most expensive of all of these listed. Just because Doxycycline is a generic, you can get it at Walmart for $4. So keep that in mind when you are prescribing medications. We need to make sure we know what insurance the patient is on, if any, and if there is a generic form available, you need to make sure you are taking that into consideration.

We know the spectrum of bacteria is gram positive and gram negative. With respect to the lids, we are typically dealing with gram positive staining bacteria. The majority of the bugs will be either staph or strep, which are gram positive.

We also have narrow-spectrum antibiotics, and things like isoniazid is only used for tuberculosis. It is not used for anything else. That is pretty narrow spectrum. So we have narrow spectrum, we also have extended spectrum and broad spectrum. The broad spectrum antibiotics affect more bacteria, so they are not necessarily selective in what they are killing. Something like chloramphenicol is broad spectrum. Broad spectrum antibiotics increase your potential for toxicity.

4. If a typical antimicrobial completely eliminates the organism from the body, it is referred to as what?
    a. Bacteriostatic
    b. Bacterioselective
    c. Broad spectrum
    d. Bactericidal

Scroll down when you have chosen your answer.

The correct answer is d – bactericidal. The bacterioselective one tells you that it's very selective in what it kills. The bacteriostatic stops the bacteria's ability to replicate, but does not kill the bacteria already present. And your broad spectrums just have a variety of bacteria that they kill.

5. Which of the following patients is ***least*** likely to require antimicrobial treatment tailored to their specific condition?
    a. Patient undergoing cancer chemotherapy
    b. Patient with kidney disease
    c. Elderly patient
    d. Patient with hypertension
    e. Patient with liver disease

(Scroll down when you have selected an answer.)

And the correct answer is… d: Patient with hypertension. The patient going through chemotherapy would require us to be very specific with them, because of their compromised immune system we would not give them something that is bacteriostatic. Patients who are elderly, have liver or kidney disease, again, they may have problems with processing or elimination of that antimicrobial agent. The only one we really don't have to worry about is the patient with hypertension.

Drug resistance

Drug resistance is becoming a big issue for us. There's actually something that's called Ocular TRUST. This is the third derivation of the Ocular TRUST. What they've done is they are looking at drug resistance to different microbials. They take six different antibiotics and they actually test the resistance to that medication by a variety of different microbes, such as strep, staph, MRSA, and they've been doing this over the past 9 years to determine if we are developing resistance to our topical antimicrobials. The big one we are getting concerned about is MRSA (Methicillin Resistant Staph

Aureus). If you wanted to get a MRSA infection, where would you go? You would go to a hospital, a personal care home, or some kind of community living. It's now actually moving outside of those communities and we are seeing the general population being exposed. Thus, we are very concerned as to if we are developing resistance to our topical antimicrobial agents, particularly in regards to MRSA.

Table 2: Isolates Submitted in Ocular TRUST (OT) 1-3

	OT 1 (2006)	OT 2 (2007)	OT 3 (2008)
Staphylococcus Aureus	**197**	**155**	**162**
MSSA	164 (83.2)	71 (45.8)	84 (51.9)
MRSA	33 (16.8)	84 (54.2)	78 (48.1)
Coagulase-negative staphylococci (CNS)	---	**92**	**79**
MSSA		40 (43.5)	30 (38.0)
MRSA		52 (58.5)	49 (62.0)
Streptococcus pneumonia	**49**	**198**	**121**

- OT columns: N(%)

They've got about 104 different institutions, and they are looking at fluoroquinolones, such as ciprofloxacin, gatifloxacin, moxifloxacin and levofloxacin, but they don't have the newest ones, such as Besivance. Azithromycin, trimethoprim, polymyxin B, and tobramycin are all looked at. They also have a bunch of different isolates: S. aureus, MRSA, and MSSA (Methicillin-susceptible S. aureus) are in this group, as well. (See Table 2) At this point, pretty much everything is resistant to penicillin – it's not really used that commonly unless it's used as an IV or an IM injection for things like syphilis. Interestingly enough, trimethoprim and tobramycin have better MRSA activity than the fluoroquinolones do.

Their findings include:

- Most antimicrobials, except penicillin and polymyxin B, continue to be highly active against MSSA (azithromycin shows only moderate activity).
- With the exception of trimethoprim and tobramycin, less than 1/3 of MRSA strains are susceptible to ophthalmic antimicrobials.
- Susceptibility profiles remain virtually identical for the fluoroquinolones, regardless of methicillin phenotype.
- S. aureus is more susceptible to the fluoroquinolones than to macrolides, as represented by azithromycin.
- Less than 50% of methicillin-resistant CNS isolates are susceptible to ophthalmic antimicrobials, except for tobramycin and trimethoprim, which are somewhat more active.
- S. pneumoniae susceptibility profiles for fluoroquinolones are virtually identical, except for modestly lower susceptibility rates for ciprofloxacin.

If you were going to have a patient with a corneal ulcer, what would your treatment be? We would typically start with Vigamox (moxifloxacin) or Zymar (gatifloxacin). We would typically start with a loading dose, say 2 drops every 15 minutes for the 1st hour or so. You may actually want to throw tobramycin or gentamycin into that mix, because it's got better MRSA than the fluoroquinolones do.

The other one to consider is trimethoprim. Which of our antimicrobial agents has trimethoprim in it? Polytrim! Polytrim is not one of the antibiotics that I tend to use a lot, but the great thing about Polytrim is that it's approved up to 2 months of age. Pediatricians love Polytrim because most medications only are approved up to about a year, but they can use Polytrim on younger patients. So that is another one you may want to throw into the mix if you're concerned about MRSA.

To determine if an ulcer is not getting better, usually we will wait about 48 hours to determine that. If it's not getting worse, then it's either staying stable or getting better. This is because without effective treatment, an ulcer will get worse as time goes on. If after 48 hours you are not seeing significant improvement, I would suggest that you need to culture that to find out what kind of bug we are dealing with, or be concerned about MRSA.

Antibiotic Classes

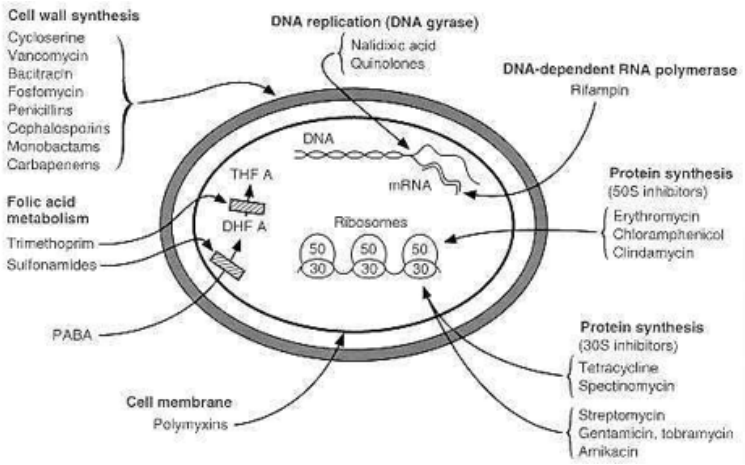


Figure 3: Sites of Antimicrobial Actions. Antibiotics can be classified by their chemical structure, the organisms they are effective against, or by their site of action.

Now I am going to talk about the different antimicrobial agents by breaking down what the affect in the cell. We have five basic groups that we are going to deal with. The first one is the inhibition of cell wall synthesis. This is the penicillin group. Remember that humans don't have cell walls, so if you can inhibit that production of the cell wall, then the drug is not very toxic to human cells.

The very first antimicrobial agent group that we had were the penicillins. (Described in the upper left corner of Figure 3) They are very gentle to our system, again because we do not have cell walls. The downside to this group is that a lot of things are now resistant to it.

Two major subgroups in here are the beta-lactam ring antibiotics, and vancomycin. Within the beta-lactam group, we have the penicillins and the cephalosporins. What ends up happening in the penicillin group is you have a beta-lactam, and that's the active component to this antibiotic. Resistant bacteria produce a penicillinase, which cleans out that beta-lactam ring, rendering the antibiotic ineffective. What we can do is add in an inhibitor of that – a beta-lactamase inhibitor, such as clavulanate, which prevents the beta-lactamase from cleaving off the beta-lactam ring, thus making the antibiotic effective again.

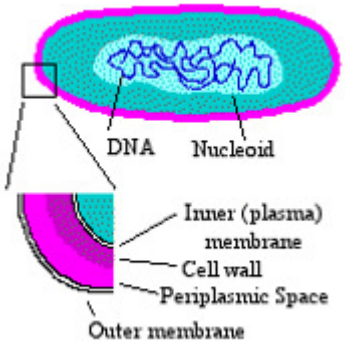


Figure 4: Bacteria cell wall schematic

These are bactericidal, with good gram positive coverage. They have a little bit of gram negative coverage, as well, but they are not great for gram negative. Amoxicillin is probably your major antibiotic in this group. At this point, staph is pretty much resistant to amoxicillin. Generally we use it primarily on kids with inner ear infections, but we are shifting away from that due to the fact that the bacteria is almost completely resistant, and the most likely bug in an ear infection is staph. It is also used in the treatment of sinusitis and infections caused by susceptible staph/strep involving the upper and lower respiratory tract, skin, and urinary tract, as well as for prophylaxis against infective endocarditis.

The great thing about amoxicillin is that it's got great soft tissue penetration. For us, dealing with soft tissue, this is a great antibiotic; but we need to shut down the bacteria's ability to cleave off that beta-

lactam ring. At this point, you would not want to prescribe amoxicillin for something like a pre-septal cellulitis or anything like that, however, because the most likely bug that is there is staph, and that staph is probably resistant.

Adult dosing for amoxicillin is 250/500 TID, 875 mg BID or extended release 775mg QD.

Pediatric dosing is as follows:

- <3 months: oral 20-30 mg/kg/day divided q12 hrs
- >3 months: oral 20-50 mg/kg/day divided 18-12 hrs
- >12 yrs: extended release 775 mg daily

Dicloxacillin actually has its own natural ability to shut down the penicillinase, so it has a natural penicillinase resistance. We don't tend to use dicloxacillin an awful lot, and I'm not sure why. Perhaps it's because it's dosing is QID. Remember with patients, the fewer number of times they need to take the medication, the better off we are. In regards to compliance, first off: all patients lie. They always tell us they are taking their medication the way they are supposed to. Just like we would ask a contact lens wearer not "Do you sleep in your contact lenses?" but instead, "How often do you sleep in your contact lenses?" You get a little bit more honest answer that way. I had a patient recently that I didn't do great patient education with, and when I asked her if she took her drops four times a day, she told me, "Yep – I take them four times in the morning and I'm good to go!" No… it's breakfast, lunch, dinner, and before bed. But she thought that since she took them four times in the morning, that's OK. Thus, make sure that you are talking to your patients, and remember that the fewer times they have to take the medication each day, the better off they will be. That's why Z-paks are so good – they come in little blister packs, and we know that the patient takes 2 pills the first day, and then one pill for the next four, and they're done.

Dosing for dicloxacillin in adults is 250 mg q6 hrs. Dicloxacillin needs to be administered PO at least 1 hour before or 2 hours after meals.

Dosing for pediatrics is as follows:

- Children <40kg: 12.5-25 mg/kg/day divided
- Children >40kg: 125-250mg q6 hrs

Penicillin G and Penicillin V are really only used for syphilis, and they are administered as either an IM or an IV injection. (Table 3)

Ampicillin is really only used for patients who are undergoing dental surgery to prevent problems with their heart. It is also good for haemophilus, so you may see it in kids, but generally we don't prescribe this.

Nafcillin again is really only IM or

Table 3: Indications and administration guidelines for select penicillins

Name	Treatment for	Administration
Penicillin G and V	All stages and forms of syphilis	Via IM or IV injection
Ampicillin	Prophylactic use in dental surgery patients Active against haemophilus and salmonella	Adults: • 250-500 mg q6 hrs
Nafcillin	Osteomyelitis, septicemia, endocarditis and CNS infections	IM/IV Adults: • 500 mg q4-6 hrs

IV. We may see this in a patient that is dealing with an orbital cellulitis or potentially an endophthalmitis. In that case, nafcillin may be thrown into the mix. Again, not something that you will likely be prescribing.

Table 4: Augmentin

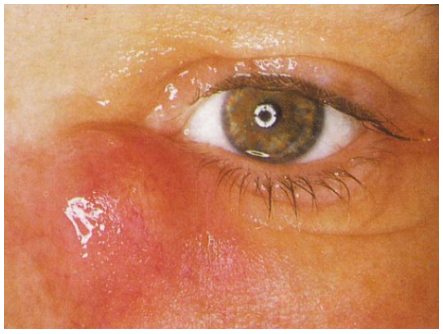
Name	Treatment for	Side effects:	Dosing
Augmentin • **Amoxicillin** • **Clavulanate**	Skin infections such as: • Dacryocystitis • Internal hordeola • Pre-septal cellulitis Treatment of: • Otitis media • Sinusitis • Lower respiratory & urinary infections As prophylaxis to dental surgery patients	LOW: • GI upset • Allergic reaction or anaphylaxis Serious complications: • Anemia • Pseudomembranous colitis • Stevens-Johnson Syndrome	Adults: • 250-500 mg tab q8 hr • Or 875 mg q12 hr (BID) • 1000 mg XR: q12 hr and not for kids <16 Peds: • <3 mos 30mg/kg/day divided 112 hrs using suspension • >3 mos 45-90mg/kg /day divided q12 hrs

Augmentin is the big one that you need to remember from the beta-lactam antibiotics. It is amoxicillin – do you remember what I said about amoxicillin above? Staph is resistant to it. So we add the beta-lactamase inhibitor, which is clavulanate 125 mg, and that doesn't change no matter what you're dosing. Your dosing is really based off of the amoxicillin component – the clavulanate is 125mg no matter what. Clavulanate is just an enzyme that shuts down the bacteria's ability to cleave off the beta-lactam ring.

With your dosing, generally we are going to do 250 or 500 mg TID or 875mg BID. I prefer 875 mg BID just for the less frequent dosing, but they are huge pills at 875. You can get this in a liquid form, as well as in an extended release (XR) form, which is 1000 mg, but the XR formulation is contraindicated in patients under the age of 16. Remember that your dosing on this is based off of the amoxicillin.

Remember also that amoxicillin has really good soft tissue penetration, which is good for us. Generally I wouldn't use any of the penicillin groups for staph, or hordeola, with the possible exception of dicloxacillin. However, generally we have better antibiotics, and we can use something like doxycycline, but you could potentially use that. Remember, if you're going to do it, it needs to either be dicloxacillin, which has its own natural penicillinase resistance or something like augmentin.

Figure 5



I would consider using augmentin for something like dacryocystitis. Dacryocystitis is in infection of the lacrimal sac. Looking at Figure 5, how would you separate this out from, say, a pre-septal cellulitis? What is the easiest thing for you to do? Press on it! If you press on it, what is going to happen? Pus will come out of the lacrimal sac. If it's a pre-septal cellulitis it's going to hurt, but nothing is going to come out of the sac.

Generally a dacryocystitis is located right in that inferior nasal area, while pre-septals tend to spread more throughout the tissue. In this case, we would prescribe augmentin say, 500 mg TID or 875mg BID. You could also throw dicloxacillin in there, but the downside of dicloxacillin is that it is QID dosage.

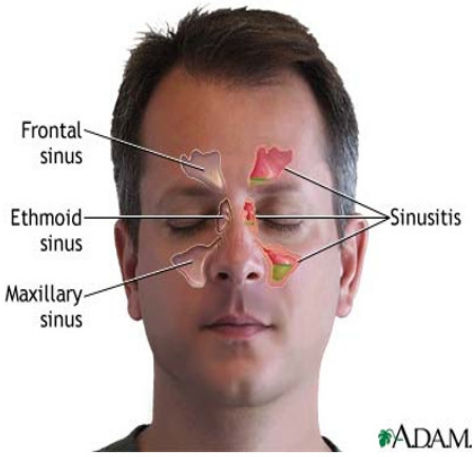
Pre-septal Cellulitis

6. Which of the following could be the cause of a pre-septal cellulitis?
    a. Sinusitis
    b. Trauma
    c. Internal hordeolum
    d. All of the above

And the correct answer is d – all of the above. If you had to pick the one of these that was the most likely cause of a pre-septal cellulitis, what would it be? I would say sinusitis. We typically talk about trauma, and it certainly can lead to cellulitis if you have a penetrating wound or a bee sting, or something like that, but the most likely cause overall of a pre-septal cellulitis is sinusitis.

We have eight sinuses that completely surround our eyes. (Fig 6) Most patients that come in complaining of pain to their eye, their pain very rarely has anything to do with the eye itself. The eye is very good about telling us if it is a problem with the eye, itself – we get red eyes, discharge, photosensitivity, those types of things. If a patient comes in with a completely white eye, and they say they are feeling a pain around or in their eye, 9 times out of 10 it's a sinus problem. We have no pain receptors in the back of our eye, and nothing on the retina is going to result in pain, so if it's pain around the eye, look to the sinuses. Sinusitis is the most likely reason why we get pre-septal cellulitis.

Figure 6: Locations of cranial sinuses



The second most common reason patients get pre-septal cellulitis is because of a hordeolum. If you think about that, the gland is plugged up, and it will form a fistula because it wants to get that bacteria and get that pus out of there. A friend of mine recently came in who said, "I've got this hordeolum, and it's really painful." I pulled down the lid and I saw all of this pus coming out. It had developed a fistula into the lower part of his cul-de-sac. If it had gone any other direction, it would have resulted in a pre-septal cellulitis. That is why we talk to patients about doing lid hygiene, and how we don't want to press on the hordeolum because we don't want that pus to get into the surrounding tissue and spread, causing a cellulitis.

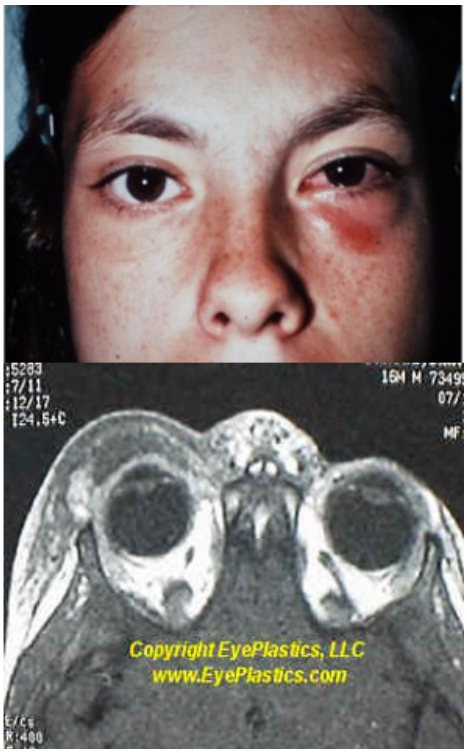


Figure 7: (Top) Pre-septal cellulitis OS. (Bottom) MRI of a pre-septal cellulitis OS

So the first most common reason for a pre-orbital cellulitis is a sinusitis, followed by a hordeolum, and then in third place we have trauma.

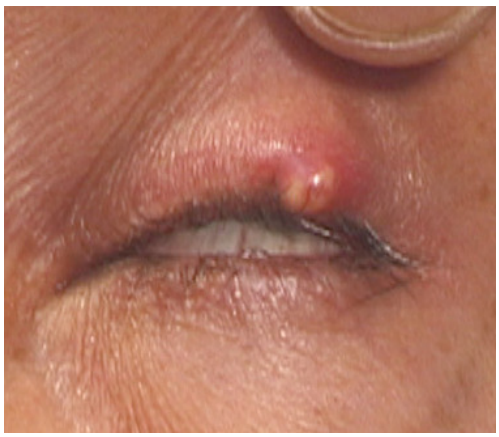
Figure 7 is a pre-septal cellulitis. Characteristics we look for in a pre-septal cellulitis include obviously a swollen, painful lid, but pretty much nothing else in the eye is going to be affected. The visual acuity (VA) is going to be fine. There will not be any pupil changes, nor will there be any restrictions to the EOM's. There may be pain on EOM's, but no restrictions. They will not have an APD. A low-grade fever is a possibility. Generally most patients with a pre-septal cellulitis will not have a fever, but they may have a low-grade one.

Now, how can you check temperature in your office? Generally we don't think about doing a thermometer because then you have to clean it or autoclave it somehow. There are actually disposable thermometers that are called Tempa Dots, and most of the primary care physicians I know use them now. The put

them under your tongue for a minute, they light up with a little blue dot, then you throw it in the garbage. They're like fluorescein strips – you just buy a box of 60 of them. I would recommend that you have those in your office so you can check a patient because one of the key differentiating characteristics between an orbital cellulitis patient and a pre-septal cellulitis patient is that all orbital cellulitis patients are sick patients. They will definitely have a fever. If your patient has a fever, I get more concerned that there is an orbital cellulitis present.

Treatment-wise, I would definitely go with augmentin in this case, probably 875mg BID for 7-10 days. If there is a fever or this is a child, I would be a little more concerned that we would need to do some type of systemic treatment, like with an IV. At that point, I would probably punt them. If there was a fever that was found, I would definitely have them scanned to make sure there is not an orbital component to the infection, and then I might send them for IV Fortaz (ceftazidime) 1-2 g q8h, which is one of our cephalosporins, which we will talk about in a minute.

Figure 8: External hordeolum



7. So if you are treating the condition pictured in Figure 8, you culture it, and you realize it's a penicillin-resistant strain. Which of the following would you use?
    a. Amoxicillin
    b. Ampicillin
    c. Dicloxacillin
    d. Penicillin G

(Scroll down when you have selected an answer.)

The correct answer is dicloxacillin. It has its natural penicillinase resistance. Remember in this case, amoxicillin is not going to work for you because staph is almost completely resistant to amoxicillin. Thus, dicloxacillin is your best option with this one.

Cephalosporins

Cephalosprins have very similar activity to the penicillin group. If your patient has a true allergy to penicillin, the cross-reactivity between penicillin and cephalosporin is about 10%. If they don't, the chance that they are allergic to cephalosporin is about 1%. Physicians will actually write a prescription for a cephalosporin for patients that have a penicillin allergy, but they will watch the patient closely because of that 10%. As I said above, cephalosprins work very similarly to penicillins, but they have a little bit more beta-lactamase resistance than the penicillin group.

They do have poor oral administration, so the majority of cephalosporins end up being administered via IV or IM. I will tell you about three of them that I want you to keep in your arsenal because they have really good oral administration. Dermatology loves cephalosporins because they have great soft tissue penetration. A lot of times if you go to the dermatologist and end up having any kind of skin issue, they are more than likely going to give you a cephalosporin, something like Keflex, Ceclor or Duricef.

Cephalosporins come in different generations. (Table 5) As you go up in generations, from 1st to 4th, you get better gram negative coverage, and also a dramatic increase in price. Probably the most common ones you need to remember are as follows:

- Duricef
- Keflex
- Ceclor

These three you need to keep in your arsenal because they are orally administered. You will see the other ones, as they are treatments for things like orbital cellulitis and endophthalmitis. Probably the most common is ceftriaxone, which is Rocephin.

The downside to the cephalosporins is that they are QID administration. Keflex is 500 mg QID. It has really good soft tissue penetration, so it is vital that you keep this one in your arsenal.

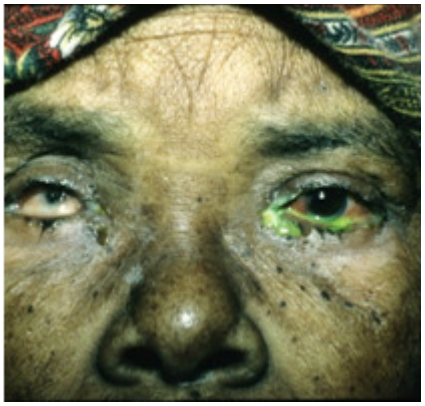
Table 5

	Cephalosporins	Orally administered
1st generation	Duricef (cefadroxil) Ancef (cefazolin) Keflex (cephalexin) cephalothin	Duricef Keflex
2nd generation	Ceclor (cefaclor) cefprozil Zinacef (cefuroxime) cefotetan cefoxitin	Ceclor
3rd generation	cefnir cefixime cefotaxime (Claforan) ceftazidime (Fortaz) ceftibuten ceftizoxime ceftriaxone (Rocephin IM/IV)	
4th generation	cefepime	

8. Which of the following would be the most likely causative agent for a patient presenting with a hyperacute conjunctivitis?
    a. Staph species
    b. Neisseria species
    c. Strept species
    d. Haemophilus species

The correct answer is Neisseria species, which gives you what? Gonorrhea. That's what's giving you that hyperacute state. Staph and Strep give you more of a chronic conjunctivitis. They can give you a discharge but generally with your hyperacute discharge, it's usually the gonococcal infection, which is Neisseria. In this case, the patient would have a discharge, you would lavage them, and then more discharge would come out.

Figure 9: hyperacute conjunctivitis caused by Neisseria gonorrhoeae



If you were to guess how many true bacterial conjunctivitises you are going to see in your career, about how many are you going to see? About 5. They are very uncommon, but we teach and train you about them because there is a chance that they can result in a perforation and an endophthalmitis. But a true bacterial conjunctivitis we don't tend to see many of them in adults; we see them more in kids. If you work with a pediatric population, you are much more likely to see a bacterial conjunctivitis than you would see if you were working with adults.

In this case, you need to treat the systemic condition, so you can do an IV or an IM injection of ceftriaxone 1g. But remember that you also need to address the topical stuff, as well. We have discharge, bacteria and lymphocytes that are in there and we don't want to chance an ulcer formation so after you lavage, add a topical antibiotic, as well. A fluoroquinolone like ciprofloxacin, moxifloxacin, gatifloxacin, or besifloxacin would all work. You know besifloxacin (Besivance), which is our newest topical, is actually a chlorinated fluoroquinolone. This one is TID dosing instead of QID.

Indication-wise, however, besifloxacin doesn't have as good penetration into the eye as, say, moxifloxacin does. Thus, if you are wanting to get the medication into the anterior chamber, besifloxain doesn't do as good of a job as, say, Vigamox. There has also been some indication that Besivance is better for MRSA. Most of our topical antibiotics come from systemic meds, and thus are already being used systemically. Besivance is not – it is only available topically, so you cannot find it in an oral administration. Thus our hope is that we will not find that it develops nearly the resistance our other oral antibiotics have.

A brief review

Dacryoadenitis is an inflammation or infection of the lacrimal gland. It may be secondary to either viral or bacterial, but generally you are not going to know that unless you actually culture it. If it's viral, doing an antimicrobial agent is not going to help you, but generally we're going to treat it that way anyway, on the assumption that there might be a bacterial component to it.

Again, treat with Keflex 250-500mg QID.

For pre-septal cellulitis, I really like augmentin for pre-septals, but you can certainly use Ceclor or Keflex. The big one with this is to make sure if there is a fever that is there, and your patient is sick, you may want to consider imaging. If it is truly an orbital cellulitis there will be other eye signs – decreased vision, an APD, and things like that. If they don't have those other signs, orbital cellulitis is not likely, but you may still want to consider doing an IV or an IM administration. I'll talk to you about a patient later

who came in with a very swollen lid. She actually had IM Rocephin done just because of the concern that there may be a MRSA infection, which it did end up being.

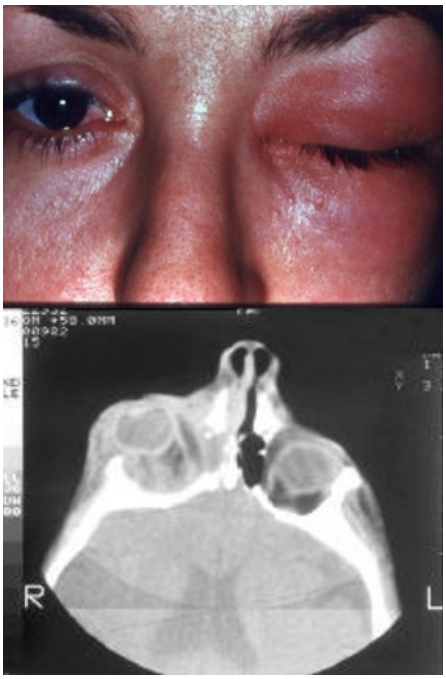
9. Which of the following are key characteristic differences between a pre-septal and an orbital cellulitis?
    a. APD present in orbital
    b. EOM restriction present in orbital
    c. Fever present in a pre-septal
    d. Decreased vision present in orbital
    e. All of the above are correct

(Scroll down when you have selected your answer(s))

A, B and D are correct. Fever may be present in a pre-septal cellulitis, but it is <u>always</u> present in an orbital cellulitis. APD is present in an orbital, as is EOM restriction. Remember we are talking restriction, not pain on EOM's. In a pre-septal cellulitis, moving their eye may be painful, but there will not be a restriction from the EOM's. And you will have decreased vision in an orbital, as well. These three are huge differences to differentiate between orbital and pre-septal cellulitis. A pre-septal cellulitis will not have any other effects to the eye, other than the swollen lid. You will rarely ever have an orbital patient come to you, because they are sick patients. They are not going to come in nice and spry saying, "I think my eye's a little bit swollen." They are too sick.

Figure 10 is an orbital cellulitis. Again, just to show you on the MRI, you can see the infection behind the orbital septum. The patient had decreased VA, a red eye, headaches, diplopia, bulging eye, and EOM restrictions.

Figure 10: (Top) Orbital cellulitis. (Bottom) MRI of patient with orbital cellulitis OD.



In this case, I'm just going to give you the treatment that they do for the first week:

- The patient will be hospitalized
- Using IV ceftriaxone, which is Rocephin, based off of the patient's body weight.
- They also may be given vancomycin or clindamycin.

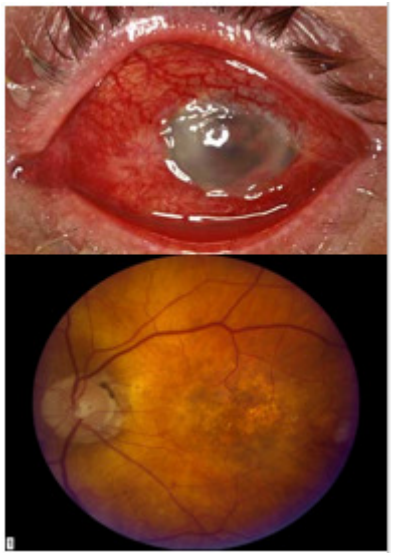
Table 6

Orbital Cellulitis Treatment	
IV Antibiotics for 7-10 days	IV ceftriaxone (Rocephin) 50 mg/kg/q12h/day or IV cefotaxime (Claphoran) 50 mg/kg/q6h/day
	Plus: IV clindamycin 40 mg/kg/day in 3 doses
If patient has a penicillin allergy	IV vancomycin 30 mg/kg/day in 3 doses infused over 90 minutes
Oral treatment 2-3 weeks post IV	amoxicillin-clavulanate (Augmentin) 875 mg/125 mg PO q12h or cefpodoxime 200 mg PO q12h or cefdinir 600 mg/day PO q12h

Vancomycin is one of our last-ditch medicines, we try to reserve it for patients who have MRSA infections, and it has to be done by an infusion. This regimen is done for the first 7-10 days, and then after that the patient will go on an oral administration of Augmentin or Keflex, or something like that. (See Table 6) Your concern in this case is that this infection can attach to the nerve, track back to the brain, and kill your patient.

If your patient is diabetic and has an orbital cellulitis, what bug are you concerned about? Fungal! It's actually very likely a fungal infection. This is very scary because it's almost impossible to treat the fungal infection. Patients who are diabetic who have ketoacidosis, meaning they don't have good control, the ketoacidotic process that they go through leads to a very hospitable environment for fungal infections. If your diabetic patients develop pre-septal or orbital cellulitis, your big concern is that the infection is secondary to a fungus.

Figure 11: (Top) Conjunctival and corneal appearance in a patient with endophthalmitis. (Bottom) Posterior pole of a patient with endophthalmitis.



Endophthalmitis

Your most likely reason that the patient will develop an endophthalmitis is secondary to what? Surgery, particularly cataract surgery, is the most likely cause. The chances of developing an endophthalmitis secondary to a cataract surgery is probably less than 0.5%. But, if that happens, obviously, it's very devastating to vision. The most likely bug that's going to cause it is staph (80%), coming from the lids. Followed by strep (10%), and about 6% gram negative and 4% assorted other gram positive bacteria. So there's a lot of lid hygiene that goes on prior to surgery, with a lot of surgeons now recommending lid scrubs and topical antibiotics before the patient comes in for surgery. The crucial component is actually the surgical field that they are dealing with. Doing some pre-treatment helps, but maintaining a sterile surgical field, and killing all the bugs that are there, and then post-treatment are more important. You want to have a good antibiotic that is going to have good penetration into the anterior chamber post-surgery. Typically we use a 4th generation fluoroquinolones for about a week after the surgery.

Patients with endophthalmitis will present with:

- Pain
- Photophobia
- Discharge
- Red eye
- Decreased Vas
- Proptosis
- Corneal edema
- Injection
- KP's
- AC reaction
- Vitritis

Any patient that goes through cataract surgery and ends up developing a red eye or a painful eye, they need to be seen. When I was in Memphis, one of my colleagues who worked at a co-management site, probably one of the smartest optometrists that I know hands-down, had an 80 year old female patient call him and say, "I'm in pain after my cataract surgery." He told her to come in, and she replied, "I don't have transportation." Which is, actually, something that you need to make sure during your initial work-up is that the patient has transportation. This should have disqualified her for surgery. Of course, the patient developed an endophthalmitis and lost the eye, and sued. Remember – it's a jury of peers, but not <u>your</u> peers. They actually found in favor of the patient, and said the OD should have gone and picked her up. Now, it was overruled, but they saw that the doctor had malpractice insurance and a woman who'd lost her eye, and they wanted to give her some money. My recommendation is not necessarily to go pick up your patients, but if they have gone through cataract surgery and have developed a red, painful eye, they need to be seen, because chances are they've developed an endophthalmitis.

Table 7

Endophthalmitis Treatment	
Intra-vitreal	vancomycin 1mg/0.1mL and ceftazidime (Fortaz) 2.25 mg/0.1 mg (or amikacin)
Sub-conjunctival	vancomycin 25mg and ceftazidime (Fortaz) 100mg (gentamicin) and dexamethasone 12-24mg
Topical	fortified vancomycin (Vancocin HCl 2.5% Ophthalmic) and ceftazidime (Fortaz) 50mg/mL/hr, and topical steroid and cycloplegic
Systemic (controversial)	IV systemic antibiotic

At that point, treatment-wise, the surgeon does everything, including throwing the kitchen sink at them. They actually culture the vitreous to find out what bug is there, then they will flood the vitreous with vancomycin and usually some form of a steroid, as well. They will do sub-conjunctival injections and will also do topicals. They literally throw everything in there. The only thing that is controversial is if they also do an IV systemic antibiotic, and the reason that's controversial is that they don't know whether or not it works. Even with that all being done, the chance of that eye being saved is usually minimal.

Vancomycin and bacitracin both inhibit cell walls, so they work very much the same way as your penicillins or cephalosporins. You can use vancomycin if the patient has a penicillin allergy. These are considered a little more last-ditch, and we try to reserve them more for our MRSA patients, but we are starting to see some resistance to vancomycin, as well.

Bacitracin has very good gram positive coverage, but almost no gram negative. You do not use it systemically – it is only used as a topical administration. It is too toxic to the system otherwise. We also need to throw something in there to give us gram negative coverage, so it's usually used in combination

with something else, such as polymyxin B to make bacitracin. Most of our lid stuff will be gram positive, so it's not bad to use by itself on something like blepharitis.

Vancomycin is usually administered systemically via an infusion that is done over time. You cannot give the patient a big bolus, because they will have too many side effects. Usually we do an infusion over about 90 minutes to reduce the rash and breathing issues the patient can get. Side effects can include anaphylaxis (hypotension, wheezing, dyspnea, urticarial, pruritis), upper body flushing, pain secondary to muscle spasm, nausea, diarrhea, and/or headache. Typically the most serious complication, though it is infrequent, is nephrotoxicity.

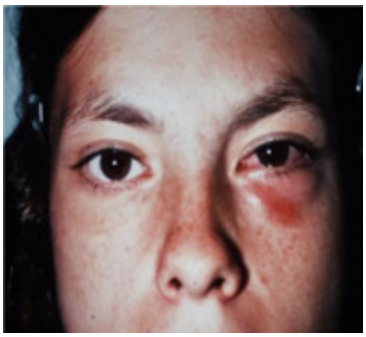
You can get vancomycin as a topical administration, but it has to be compounded for you. You will typically find someone in your area who will do a compounding – most pharmacies won't – usually there are one or two locations in a city, and almost all hospitals will have a compounding pharmacy. This is basically a fortified formulation. If you have a patient with a corneal ulcer, and you are concerned that they may have a MRSA infection, I would recommend getting fortified vancomycin to do topically.

10. A 25 year old male presents with a purulent red eye. He reports no current medical conditions that he is being treated for, but he recently returned from a holiday and had a really good time. He also has painful urination with some discharge. What would you treat him with?
    a. Ceftriaxone IM
    b. Vancomycin IV
    c. Penicillin G IM
    d. Bacitracin IM

(Scroll down to the next page when you have selected your answer)

I hope you did not choose option d. Bacitracin is not used systemically, only topically. The correct answer to this is ceftriaxone IM. You could actually do vancomycin, but at that point you're sending your patient in for an IV. It's much easier to give him a shot IM than to send him in for an IV. Penicillin G we did say was used for one of the STD's, but our patient has gonorrhea. What do we use penicillin G for? Syphilis.

Figure 12



11. A 13 year old patient presents with a painful and swollen lower lid and cheek. (See Fig 12) She reports a low grade fever, but no loss of vision, diplopia, or pain on eye movement. Which of the following would you prescribe?
    a. Bacitracin ung BID
    b. Amoxicillin 875 mg PO BID
    c. Vancomycin IV 30 mg/kg in 3 divided doses
    d. Ceclor 500 mg PO TID

(Scroll down when you have selected your answer.)

The correct answers are b and d. The best answer, however, is d. Why is b not the best answer, although you could use it? The most likely bug that is causing that pre-septal cellulitis is staph. Amoxicillin is good if you include something else – make this into Augmentin by including a beta-lactimase inhibitor, clavulanate. So, technically, while you could go with amoxicillin, not the best choice for me, though you may get lucky and it may work. The best answer to this one is Ceclor 500 mg PO three times a day. Bacitracin again, ointment-wise, will not penetrate to take care of that infection. You could use vancomycin, but I would consider that if your patient had a fever, or was sicker than most pre-septals. Again, you'd have to do this via IV, and that's not very convenient for your patient.

Protein Synthesis Inhibitors

Let's move on to protein synthesis inhibitors. These groups we tend to know really well – these are our tetracyclines, aminoglycosides, and macrolide groups. They are not used very often systemically to treat many conditions. The tetracycline group has been around so long that almost every bug knows it, and has resistance. Chloramphenicol is also in this group – again, a great antibiotic – it kills everything, including the patient, so we usually leave this as last-ditch therapy.

How many patients have you seen lately who have Rocky Mountain Spotted Fever? We use tetracyclines for this, but since no one gets it, they aren't used that often. Pretty much every other condition, tetracyclines aren't used for. Interestingly enough, it is used for chlamydial infections – that's something that I just recently found this out. Generally most people end up doing Azithromycin 1g PO, but recent literature has shown that doxycycline, which we don't generally think of as a potent anti-microbial drug, can be used as 100mg doxycycline BID for 1 week, and that has a better result than 1 gram of Azithromycin PO, likely to doxycycline's anti-inflammatory component, as well as due to the fact that we're doing it for a longer amount of time. Those are actually our two treatment protocols for chlamydia.

We have lots of resistance to deal with in this group. The big side effect, obviously, in this group is phototoxicity, so you need to warn your patients to be careful with sun exposure. It's also not indicated for patients under the age of 8 because it will deposit on growing tissue, deposit on the teeth, etc.

The other one that is important to know is that if your patients are using this for acne, particularly women, pseudotumor is a big risk in this group, as well.

We don't generally use tetracycline because its dosing is hard: 250 mg QID and it's restricted by food, so they need to take it 1 hour before, or 2 hours after a meal. This schedule really limits your ability to take that medication. Whereas with doxycycline and minocycline, you want to take it with food to offset the GI upset that you get. Also, doxy and minocycline are BID dosing rather than QID. Thus, we generally don't use tetracycline at all, because it's dosing is higher and extremely limiting with respect to food.

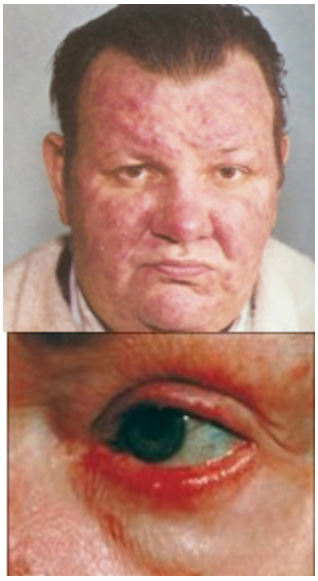
Personally, I prefer doxycycline. Minocycline is a very good antibiotic, but the downside to it is that it has a lot of CNS issues – patients can have ringing in their ears, vestibular issues, etc. that are much more likely with minocycline compared to doxy.

12. What is the underlying cause of the "acne" in patients who have acne rosacea?
    a. Purulent discharge secondary to staph infection
    b. Infection of the pores resulting in acne formation
    c. Production of lipases by the local bacteria
    d. Production of staph exotoxins

(Scroll down when you have selected your answer.)

The correct answer is c. What ends up happening in this case is that it's not true acne, where you get the pimples and the blackheads, which is actually a true infection. This is the production of the bacteria producing lipase, which is very inflammatory to the tissue, causing acne rosacea. The patient gets this redness due to the inflammation of the tissue due to the lipase produced by the bacteria. Treatment-wise, we don't want to actually kill the normal bacterial flora that is there, because it allows for other bacteria to come in and do more damage. What we want to do is shut down the bacteria's ability to produce lipase, and the tetracycline group does just that; it shuts down the lipase activity, which reduces that inflammatory component.

Figure 13: Typical presentations for patients with Acne Rosacea



Acne rosacea (see Fig 13) is much more common in females, but in males it is much more disfiguring. In males, it is more likely to cause damage and disfiguring damage. If you're going to predict where acne rosacea is going to present on a female, where would that be? Cheeks and maybe the bridge of their nose. How about for males? Up the center of the face and over their brows. Thus, we have different patient presentation depending on the patient's gender.

I recently had a patient who came in on a Saturday, and his face was very flushed. He said, "I just had a shower before I came in." Further questioning revealed that every time he took a shower, his face got really red up the bridge of his nose and across his forehead. That's classic for acne rosacea. Typical triggers for acne rosacea are:

- Heat
- UV exposure
- Hot liquids
- Spicy foods
- Basically, anything fun.

In women, this could potentially be misdiagnosed as Lupus, due to the butterfly rash. Remember in Lupus, the butterfly rash doesn't necessarily precede the diagnosis of Lupus. It happens in about 50% of patients, and it can happen at any time during the disease course. Generally, with lupus it's there, and it's there all the time, it's not going to be secondary to a trigger like heat or spicy foods.

85% of your patients who have acne rosacea have some form of an ocular complication that goes along with the condition. When we talk about patients who have autoimmune diseases, particularly rheumatoid arthritis, what's the major ocular complication of RA? Dry eye – 95-99% of your RA patients have severe dry eye. If your patient comes in and are on meds for RA, or have been diagnosed with RA, you need to treat the dry eye that goes along with it, because your patient has it. The same thing applies to your patients with acne rosacea – 85% of them have some form of an ocular complication, be

that a foreign body sensation, dryness, gritty feeling, etc. A lot of times that ocular complication will flare up before we can see the skin part of it. If the patient starts presenting with dry eye issues, and the demographic for that is females in their 50's and 60's, if they start experiencing ocular complications, optometry makes the initial diagnosis of acne rosacea more than anyone else does, because we pay attention to that area.

Table 8

Oral Antibiotics	Topical Treatments	Non-Prescription
Erythromycin	metronidazole (Metrogel)	Rosacea-Ltd III
Tetracycline	BenzaClin (clindamycin 1% & benzoyl peroxide 5%)	ZenMed
Doxycycline	BenzaMycin (erythromycin 3% & benzoyl peroxide 5%)	Neova Therapy
Minocycline	tretinoin (Retin-A)	Kinerase
	clindamycin 1% lotion/gel	Rosacare
	Plexion Cleanser/Lotion (sulfa 10% & sulfur 5%)	

Treatment-wise, while we can use tetracycline, I would probably use doxycycline. There is actually a form that is designed specifically for acne rosacea that is called Oracea. It's 40mg QD, and is extremely expensive. At that point, I'd use generic doxycycline 50mg for $4 from Walmart.

Table 8 is pulled from the International Rosacea Foundation website. The oral antibiotics are basically your tetracycline group. Again, I would use doxycycline 100mg for 4-6 weeks. For topical treatments, usually we get patients on Metrogel when they are done with the oral antibiotics. Metrogel is also an antibiotic, but it's a topical formulation and used for maintenance. There are other antibiotics that you can use, such as clindamycin, which has good anti-inflammatory properties, as well. We also have non-prescription options, such as Rosacea-LTD III, Rosacare, etc. These are bland ointments to try to prevent those triggers from activating the rosacea.

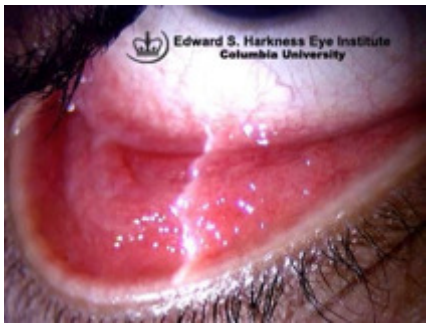


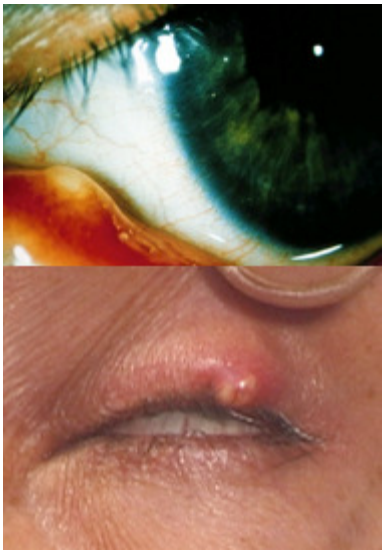
Figure 14: Adult Inclusion Conjunctivitis

Adult inclusion conjunctivitis is usually secondary to a chlamydial infection. (Fig 14) Generally when we are looking at this, we also want to check for positive lymph nodes. You know how to check for nodes, correct? Usually you want to use 3 fingers, just above the ear, and walk them down until you are just below the pinna of the ear you will feel a squish. That is a lymph node. And it should feel squishy. If you've had a previous infection, you can have a solid knot that is there. If there is a knot there, it'll be painful if it is a positive node. Squish down through the ear and under the angle of the jaw. These nodes here you need to push up on to the point where it's uncomfortable to do. Push up, and again, it'll be painful and hard if you have a positive node. The nodes further forward under the chin rarely have any ocular manifestations associated with them. The pre-auricular ones and the ones right underneath the jaw are the ones that you want to check by squishing them down. You should do a gross examination of anyone who has a red eye before you put your patient behind the slit lamp, including checking of the lymph nodes. You also need to know that positive nodes are common in what other condition? Viral – we have two types of virals: PCF and EKC. EKC is pink eye.

I once got caught on this – I had a patient who came in who had a very severe red eye, and I for some reason put them on an oral antibiotic because I just didn't feel right to me. It ended up I did the right thing, but not for the right reason. A colleague of mine came in to me, saying, "This eye just doesn't

look right to me." So then we did a gross examination and when we had the patient look down, the top part of the eye was perfectly white. It was only the lower part that was red, and when we pushed on the lid, pus started coming out of the lid. What had happened was that the patient had gotten a paper cut that resulted in an infection of the lid, causing the redness around the inferior portion of the eye, but no redness in the superior portion of the eye. I was initially thinking it was some bacterial thing or maybe weird viral stuff, but the whole eye wasn't red. Unless you do a gross examination, you won't necessarily see that.

Figure 15 (Top) Internal hordeolum (Bottom) External hordeolum



In this case of adult inclusion conjunctivitis (Fig 14), remember that I was telling you that you could do one single dose of azithromycin or you can do doxycycline 100 mg BID for 7-10 days.

Hordeola (Fig 15) – in this case, it is a bacterial infection of your meibomian glands, and you can get pus coming out of it. Doxycycline will give you good penetration into the gland, which is why we use it. You certainly can use something like dicloxacillin or Augmentin, which has good soft tissue penetration but they are a bit of a big gun to use for something like a hordeolum.

The other thing we need to determine is what is the underlying cause of that hordeolum? What else would we be looking for? Blepharitis! We have two forms of blepharitis – anterior blepharitis and posterior blepharitis. Anterior blepharitis is what we usually call 'Blepharitis' – that is the crusting and the flakes on the lashes. Posterior blepharitis is meibomian gland dysfunction (MGD). In this case, we need to look to see if the meibomian gland is the reason they have the hordeolum to start with. The glands may be producing their oils, or meibum, an inappropriate way. When we put pressure on the glands and start getting that cheesecake or cottage cheese toothpaste material coming out in contrast to that lipid olive oil appearance. What we need to do is change how the meibomian glands are producing those oils to get them back to their normal state. What is the typical recommendation for patients who have MGD? What do you tell them to do? Lid hygiene – warm compresses and lid scrubs. Realizing that we've been telling patients to do this, and it doesn't do anything because there is not enough heat to warm up those glands. They have actually analyzed the glands and oil production from them, and in a normal patient the melting temperature is much lower than the melting temperature of the oil in the glands of a patient with MGD. You can't get enough heat to actually melt the oil in those glands, so we need another way to get their glands back to a normal state. Doxycycine will do that – it gets into the gland, and the glands start producing their oils in the normal form. That'll take care of not only the infection, but it'll also get those glands working the way they are supposed to.

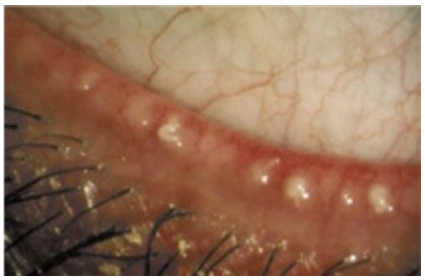


Figure 16: Plugged meibomian glands in a patient with MGD.

If you're concerned about any glands in particular for, say, a dry eye patient, which glands are you going to press on? What glands are most important glands? Meibomian glands. Upper or lower lid? Lower. Nasal, temporal or central? Central 10. If you're going to press on glands, press on the central 10

glands. Those are the most crucial for putting out tear lipid onto the eye and keeping the tear film stable.

Generally if we are going to treat the hordeolum, 50-100 mg PO BID for 2-3 weeks. If we're treating MGD and a hordeolum, we're now talking 2-3 months. There are complications to this – the patient can get GI upset, and they need to watch out for the photosensitivity that goes along with it. In women, there's another concern that we have – long courses of the older antibiotics can interfere with birth control. The newer antibiotics don't really interfere with birth control at this point. I would still recommend that you advise your patient of this. Also, yeast infections are relatively common with doses of 100 mg PO BID doxycyline. After about 2-3 weeks, we drop them down to 50 mg PO BID to avoid this.

We also have a topical medication that does the same thing as doxycycline – what is that? Azasite, which is azithromycin.

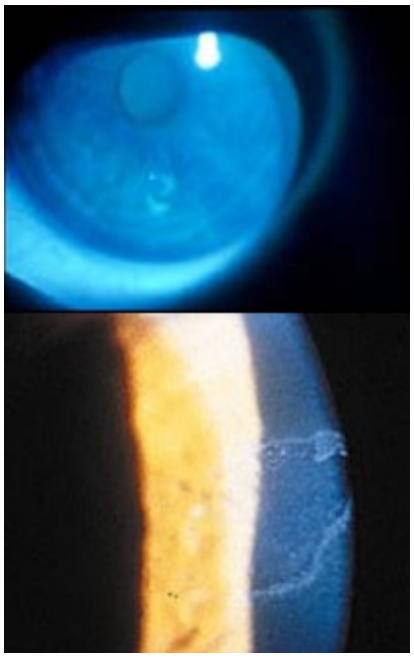


Figure 17: Two different examples of RCE's when viewed with the slit lamp.

Do you know that you can use doxycycline to treat recurrent corneal erosions (RCE)? Now you do. If you have a patient who has RCE, how do they present to you? Usually pain first thing in the morning. Usually secondary to a basement membrane dystrophy or, if it's unilateral, some form of trauma. The trauma is usually a slicing trauma – baby's fingernails are really good about doing that. It's a shearing force. Or paper cuts. Not usually just an abrasion – it takes a shearing cut. Afterwards, the epithelium doesn't stick down properly to the basement membrane, and the basement membrane starts to heap up and the epithelium can't stick down really well. Thus, one of the common things we look for is negative staining. When you put NaFl on the eye, and there is heaped up epithelium, fluorescein can't get over the mound, so you see a sort of tracking where it's not really staining or pooling over the top of those mountains.

What happens to your cornea at night time when you sleep? It swells, anywhere from 4-10%, loosening that adhesion of the epithelium to the basement membrane, the epithelium sticks to your upper lids, and thus it pulls off when you open your eyes. The pain is usually first thing in the morning, and gets better as the day goes on. Typically, this occurs in the lower 2/3 of the cornea, and thus where we want to look for RCE's.

We know that a lot of RCE's happen due to an increase in MMP-9 (matrix metalloproteinase 9) activity. That enzyme is in your collagen matrix, and it holds that collagen matrix in alignment. At elevated levels, it causes disruption to the collagen matrix, which is what happens in RCE's. Elevated MMP-9 activity doesn't allow that basement membrane to form properly, and the epithelium won't stick down to it. What we need to do is lower the MMP-9 levels, and doxycycline will do that. So will steroids.

Typical treatment for an RCE is doxycycline for 2-3 months, 50 mg PO BID, as well as a topical steroid, such as Lotemax. Both of those decrease MMP-9 activity, which means the basement membrane can

smooth itself out, and the epithelium will be able to stick down. This treatment is about 95% effective in patients.

If you have a patient who first presents for an RCE, what would your treatment be? What else could you do? Stromal puncture I wouldn't necessarily do for the first occurrence, generally. What else could you do? Muro 128! You put it in at night time, and it reduces some of the nocturnal swelling that patients get and potentially can prevent them from getting the RCE. Muro 128 stings – as a result, patient compliance over time is not that great.

What else can you do? A bandage contact lens! We have three lenses that are FDA-approved for use as a bandage CL: Night & Day, Oasis, and Purevision. I don't know if I would actually use those lenses, because what you don't want is a lens that hydrates the cornea – you want one that sucks the water out of it. Thus, I personally prefer our older materials, such as an Acuvue 2. When we do this, we generally keep it on for about 2 weeks, and when you take the lens off, hydrate the eye with contact lens solution, take a curved pair of forceps, and grab the lens and peel it off. Don't go in with your fingers again, because if you do, the potential is there that you will muck up the epithelium again.

Stromal puncture is the way you want to go if you have recurrent bouts of RCE. You do a bunch of little punctures into the basement membrane which allow it to reorganize. This treatment is about 99% effective on patients. Remember that RCE occurs on the lower 2/3 of the cornea, so your punctures will not be on the visual axis, and will not result in permanent scarring that interferes with vision.

Enucleation is always an option, as well. A little extreme, perhaps, but it is an option.

I would consider sending a first time patient for stromal puncture occasionally because it's an immediate treatment – it is done that day, and the problem will resolve without anything else from the patient. With doxycycline we are talking anywhere from 2-3 months of therapy. If you have patients that go, "Hey, wait – you're going to stick a needle in my eye not once, but multiple times? No – I don't think so." At that point, use doxycycline.

Aminoglycosides

Aminoglycosides have lots of toxicity, so we don't tend to use them an awful lot systemically, but we use them a lot topically. You should know these ones, hopefully. These are your gentamicin, tobramycin, streptomycin, neomycin, and amikacin. Amikacin is used potentially for patients that have an endophthalmitis. Again, we don't use these a lot systemically, but they are frequently used topically.

This class of drugs, like tobramycin and gentamicin, have really good gram negative coverage. From the Ocular Trust study, Tobramycin has better coverage for MRSA than your fluoroquinolones do. If we are concerned about a topical infection that might be MRSA-related, throw tobramycin and gentamicin into the mix, because they are better than your fluoroquinolones for MRSA.

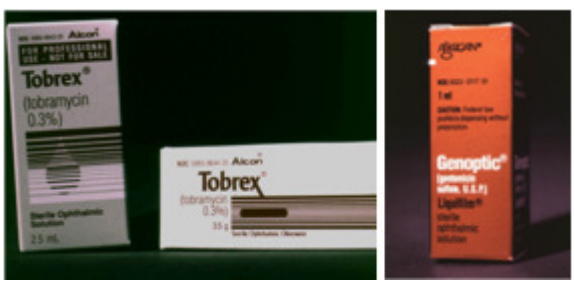


Figure 18: (Left) Tobrex (tobramycin ophthalmic ointment) (Right) Genoptic (gentamicin sulfate ophthalmic)

Tobradex is tobramycin combined with a steroid (dexamethasone). Generally if you're doing tobradex, you are using it for what? The dexamethasone. You

have a really good antibiotic that is giving you additional antimicrobial coverage, but 9 times out of 10 you're using it for the steroid. At that point, what do we typically do when we are treating conditions with a steroid? You taper it. Don't ever taper tobradex! You never want to taper an antibiotic – they should never use an antibiotic less than two times a day. If they are using it four times a day and you want to taper down the steroid, take the patient off of tobradex, and put them on a different steroid for the taper. Don't taper antibiotics – that is how resistance develops! Remember that you are treating with a steroid, but if you want to taper, put the patient on a different drug for the taper. Don't taper an antibiotic!

Macrolides

Table 9

Macrolides	
Erythromycin	125 or 250 mg cap, enteric coated
Clarithromycin	
Azithromycin (Z-pak)	500 mg first day, then 250 mg for 4 days
Telithromycin	

The major drug in the macrolides group of drugs is erythromycin. This works on the bacterial ribosome, and is very, very gentle to our system – you can give it to pregnant females. It is so gentle that everything is resistant to it – staph is essentially 100% resistant to erythromycin at this point. As a result, personally I don't see much use for this. You can get it in a topical form, as well, but again there are much better antibiotics out there. We use erythromycin because it comes in an ointment form topically, but you can get ointments in other things. You can get tobrex (Fig 18) as an ointment, you can get one of your fluoroquinolones as an ointment.

When we were going through a shortage of erythromycin, the pharmacies substituted azithromycin for it, which is a much better antibiotic than erythromycin is. If you want to give coverage, yes, erythromycin is gentle, but it's so gentle because it's not doing anything. It's like putting Vaseline on it. There are better antibiotics if you want microbial coverage.

Another big one for this group is your azithromycin, or Z-pak. The Z-pak is really good for ocular inflammatory infections, and they are probably one of the most commonly prescribed systemic medications because of its dosing. It's 2 pills for the first day, and one pill for the next four, and the blister packs come with that, so compliance is great. Azithromycin has great soft tissue penetration, is great for ocular infections, and has great anti-inflammatory properties. Thus, it's used for patients with cystic fibrosis to help clean out their lungs with its anti-inflammatory component. This was originally very expensive, but now we can get it as a generic, and thus it is much more affordable.

We can use azithromycin for gonococcal infection – 1 gram PO in a single dose. Again, remember if you're dealing with a hyperacute infection, we need to treat the systemic condition, but if there's an ocular component, make sure that you are lavaging and treating with a topical antibiotic over the top.

Adult inclusion conjunctivitis, again, we've mentioned either a single dose of azithromycin or doxycycline 100 mg BID for 7-10 days.

You certainly can use azythromycin for other things. For example, I certainly wouldn't use a Z-pak for an internal hordeola, but it is something that you can do, particularly with allergies to other medications. Say you've got a hordeola in a patient that is 8 years old. You're not going to want to use your doxycycline. This patient is also allergic to the penicillin group, which eliminates the penicillins and cephalosporins as options. Fluoroquinolones, as we will talk about, are contraindicated in patients

under the age of 16 because they can result in tendon rupture. At that point, we're not left with a lot, and you may want to use azithromycin or a Z-pak. Generally, it's not what we would use for ocular surface or pre-septal infections, but it may be what we use depending on the patient demographic.

Figure 19: AzaSite

Azithromycin you can find as an ointment, called Ilotycin. It is really not much use for us.

The other drug in this group is Azasite (Fig 19). This is topical azithromycin, and it is indicated for bacterial conjunctivitis, and its dosing is pretty much the same that you would do for the oral: 2 gtts for the 1st two days, then 1 gtt for the remainder of your treatment period.

There is no better dosing for a topical antibacterial than there is for AzaSite. Your fluoroquinolones are QID dosing, except for Besivance, which is TID dosing. This is great for a pediatric population, particularly if they are going to school because you won't need to get the nurse to put this drop in. You can just do it at night time when the patient goes to bed.

AzaSite has the same properties that doxycycline does – the anti-inflammatory properties. Thus, the same conditions that we can use doxycycline for, we can use azithromycin for, including: meibomian gland dysfunction (MGD), corneal erosions, internal hordeola, pre-septal cellulitis, and dacrocystitis (Fig 20). With MGD, it gets deep into the gland and changes how the glands produce those oils. In addition, because it inhibits lipase activity and MMP-9 activity, there's been evidence that erythromycin is very effective against RCE's. It's all off-label use at this point, though they are going for FDA approval.

Looking at this, the only treatment period time is 30 days, then you have the patient come off of the medication for 30 days. Then, depending on the situation, you may have to re-pulse dose.

Do you remember how I told you earlier that the melting temperature of meibum in a diseased state compared to a normal state is different? It's because the molecules becomes more ordered. Olive oils, and other oils that are liquid at room temperature have molecules that are less ordered. The ordered state is the toothpaste form that we are all so familiar with. If you look at the disease state and then start treating with azithromycin and through the treatment period, that state goes towards the normal. When the patient goes off of the medication, the meibum reverts to the diseased state. Doxycycline does exactly the same thing, except that it takes three months topical, as opposed to just one month. Again, this is an off-label use, but we are really pushing for it in terms of treating MGD and RCE's.

Again, dosing is 2 gtts for the first two days, then 1 gtt for the next 30 days. Usually I just write it such that they'll put their daily drop in right before they go to bed. Have the patient do their warm compresses and lid hygiene regimen, then install one drop in each eye before they go to bed. Whatever excess comes out, have them rub into their lids.

The AzaSite drop is almost like ketchup, so when they shake the bottle and it won't feel like anything's in it. They need to turn the bottle upside down and flick it, so that the medication will come to the top. It's refrigerated when you first get it, but don't put it in the fridge afterwards or it'll turn into a hard rock and they'll never get it out of the bottle.

Chloramphenicol is really our last-ditch therapy. It's a great antibiotic, is broad-spectrum, and has great toxicity for killing bugs. However, it has high complication rates – including aplastic anemia. Patients can die from this 6 months after they've stopped taking the medication, and patients have died from taking the TOPICAL administration of it. It is uncommon, but it has happened. Chloroptic is the topical formulation. In the US we don't use this, but our colleagues in the UK and Australia tend to use it an awful lot because it's the only thing that they can actually prescribe.

I threw Clindamycin in this group for you because it's indicated for some MRSA stuff. This is a synthetic compound that was really designed especially for MRSA. You may see this come up in treatments for patients who may have MRSA.

13. Children under the age of 8 should not receive tetracyclines, because these agents:
    a. Cause rupture of tendons
    b. Do not cross into the cerebrospinal fluid
    c. Are not bactericidal
    d. Deposit in tissues undergoing calcification
    e. Can cause aplastic anemia

(Scroll down when you have selected your answer)

The correct answer is d – under the age of 8 we can get deposition in tissue that is currently undergoing calcification. Rupturing of tendons is actually a fluoroquinolone. Aplastic anemia is chloramphenicol.

14. A pregnant woman was hospitalized for a UTI caused by pseudomonas, and they decided to treat her with gentamycin. Which of the following adverse affects was a risk to the fetus when she was on this drug?
    a. Skeletal deformity
    b. Hearing loss
    c. Teratogenesis
    d. Blindness
    e. Mental retardation

(Scroll down to see answer)

The correct answer is b. Ototoxicity is a big one with this. Really, we don't use this systemically at all, but the big risk factor is ototoxicity.

15. A 24 YOM presents with a red, painful eye. It started in his right eye, then transferred to the other. There is a mucousy discharge, positive nodes, follicles present in the lower palpebral conj. What do you initiate treatment with?
    a. Penicillin G IM injection
    b. Azithromycin 250mg PO for 5 days
    c. Doxycycline 100 mg PO BID for 7-10 days
    d. Azithromycin 1 gram PO single dose
    e. Chloramphenicol (Chloroptic) TID OU for 7-10 days

(Scroll down to see the answer)

I gave you two correct options on this one. Remember, you can do either a single dose 1 gram of azithromycin, or we can do doxycycline 100mg PO twice a day for 7-10 days. Why is b not correct? Look at the dosing – is that dosing correct? NO! It should be 500mg for the 1st day and then 250mg for the next 4. You could do a Z-pak for this, as well, but the given dosing is incorrect.

Nucleic Acid Synthesis Inhibitors

This is our fluoroquinolone group. There are two enzymes that this group works on: DNA gyrase and topoisomerase IV. The 3rd generation fluoroquinolones work on one or the other, and the 4th generations work on both. That's why we thought with 4th generations we wouldn't develop resistance because it affects both enzymes, while 3rd generations could only influence one. We are already starting to see some resistance to our 4th generation fluoroquinolones just because they are so commonly used.

They are all bactericidal, and have some good gram negative coverage, particularly in the lower generations. Depending on who you talk to, you will get different definitions of how the generations are classified. We typically consider the 4th generation to include gatifloxacin, levofloxacin, and

moxifloxacin. Ciprofloxacin is the most common antibiotic that has been prescribed in the US, and that is why there is so much resistance to it. Generally we don't use it that much as a common antimicrobial agent. If you do any travelling overseas, doctors tend to prescribe Cipro for traveller's diarrhea.

The mechanism of resistance that bugs have developed is that they just pump the drug right back out of their systems. They can also decrease the drug's ability to permeate into their system, or they can reduce the drug's ability to actually affect the DNA gyrase or topoisomerase IV. We are seeing resistance as time goes on.

Table 10

Fluoroquinolone Side Effects
GI upset
CNS Problems (HA & dizziness)
Phototoxicity
Liver toxicity
Nephrotoxicity
Connective tissue problems

Side effects (Table 10) include GI upset, which is common to any antimicrobial agents because it affects the normal flora that lives in your GI system. I find that whenever I take Cipro, it really messes me up, vestibular-wise. I get a lot of dizziness with it, and that's a very common side effect, in my opinion. Headaches also go along with it.

Cipro, and all fluoroquinolones, are also contraindicated in patients under the age of 18 due to potential rupturing of tendons.

Hyperacute conjunctivitis can be treated with oral cipro or moxifloxacin, again using a concurrent topical, as well, for the purulent discharge that is there.

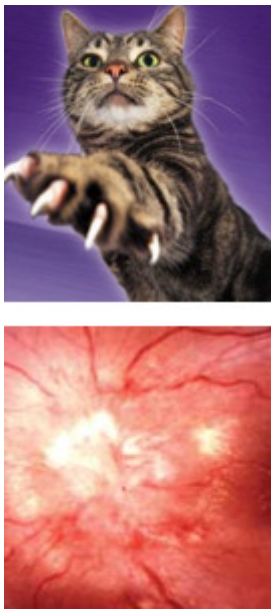


Figure 20: Top: Cat scratch Bottom: neuroretinitis due to cat scratch fever

Cat scratch fever, which should actually be called kitten scratch fever because you cannot get it from adult cats, is usually from kittens, usually from being licked by kittens – it doesn't require that you be scratched. Adult cats do not carry Bartonella, which is the bug that causes the infection – only kittens. You can get a neuroretinitis (Fig 20) that goes along with this red eye. We use oral cipro or gatifloxacin.

These are really not something that you are going to prescribe orally, though we do use them quite a bit topically. There are no contraindications age-wise topically – I believe the topical formulations are approved down to 1 year of age.

<u>Inhibitors of Metabolism</u>

The group of drugs that inhibit metabolism are the sulfa drugs; they inhibit folic acid. Bacteria need folic acid to replicate, and they must get it from an outside source. These drugs inhibit the bugs' ability to absorb folic acid, and thus they cannot replicate.

This group includes sulfonamides and trimethoprim (TMP). From the Ocular TRUST studies, TMP is probably the most effective drug we have against MRSA at this point. Even more so than fluoroquinolones are. We have actually combined the two to make an even stronger antimicrobial agent.

With the sulfa drugs, we do not prescribe them on their own because there is a high incidence of allergy to them, and also bacteria that produces any type of mucous discharge, that mucous will deactivate the

sulfa. Thus, with a mucopurulent discharge, the drug won't work and the patient is quite possibly allergic to it.

Primary care and emergency room doctors really like sulfa drugs for patients who present with bacterial conjunctivitis, which should blow you away because the bacterial discharge inactivates the sulfa, and then the patient has an allergic reaction and they present to you as worse off than they were before they started. Optometry does NOT use topical sulfas – we just don't. Emergency room physicians tend to like them for some reason.

They are bacteriostatic. Again, remember that any bacteria that produces a mucous discharge will inactivate the sulfa.

Table 11

Sulfonamide Side Effects
Hypersensitivity reactions
Angioedema
Stevens Johnson Syndrome
Nephrotoxicity
Hemolytic anemia
Drug potentiation

Our big concerns with this group are the hypersensitivity reaction and the possibility of developing Stevens Johnson Syndrome (SJS). SJS is a massive allergic response, typically to medications, that can and does kill patients due to a multi-system shutdown. Any time you are taking a medication and you get a rash or a tingling, you want to stop that medication immediately, because that may be the beginning of an SJS developing.

If your patient happens to also have diabetes, systemic sulfa drugs can change their glycemic levels. It has also been known to potentiate other medications. It has been known to take anti-coagulant medications like warfarin, and make that even worse. Thus, generally, sulfas are not something that we tend to use. There are a lot of topical administrations for these drugs, but we just don't use them in optometry.

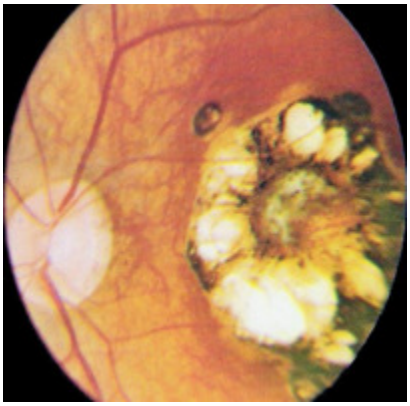
Pyrimethamine and Trimethoprim

Pyrimethamine is used as prophylaxis for patients who may develop malaria. Trimethoprim (TMP) doesn't really have any indications systemically for ocular stuff, unless there is a MRSA component. If you are concerned about MRSA, TMP may be thrown into the treatment mix, not only systemically but also topically.

Trimethoprim has good gram positive coverage, but if you want the gram negative coverage we need to throw Polymyxin B into the mix. That's where we get polytrim. I would throw polytrim on an ocular infection if you thought MRSA was involved because of the trimethoprim that is there.

Pediatricians love polytrim because it's approved down to 2 months of age. A lot of times, instead of trying to remember which drugs are approved down to which ages, they just give everyone polytrim because they know it's going to be covered. It's not necessarily the best antibiotic – the topical fluoroquinolones are much more effective at killing bugs than polytrim is, but polytrim is approved down to that low age.

Figure 21: Toxoplasmosis lesion



For toxoplasmosis, they certainly can use that, as well. Figure 21 is a very classical lesion for toxo. Toxo loves the posterior pole, and

results in extremely large lesions. We also have toxocara and histoplasmosis. These are our three bug-related retina big conditions.

What is the triad for histoplasmosis? How does it present? Peripapillary atrophy, punched-out lesions (histo spots), and potential CNV, though we don't necessarily need the third. Macular involvement and the potential to develop a sub-retinal neovascular membrane, we don't need that for diagnosis, and you hope that doesn't happen to your patient.

What about toxocara? It tends to be a bit more peripheral, and then you get this large lesion that throws tractional bands. The bug actually gets into the retina, then dies, setting up an inflammatory response that usually sends tractional bands towards the macula.

The big one that I want you guys to remember here is Bactrim. This is actually a combination of TMP and a sulfa drug. It is very, very good for skin infections, particularly MRSA. If they are dealing with a skin infection where they think MRSA is involved, because of the TMP in it, they will use Bactrim. Remember that because of the sulfa component, any contraindications that you have for sulfa still apply.

There are two dosings for Bactrim. There used to be just tablets that were 80 and 400mg. Now there's also Bactrim double strength. Originally the dosing was 2 tablets every 12 hours, so they've doubled the concentration and now it's just 1 tablet every 12 hours. Now most people just prescribe for Bactrim double strength, because there's fewer pills that the patient has to take.

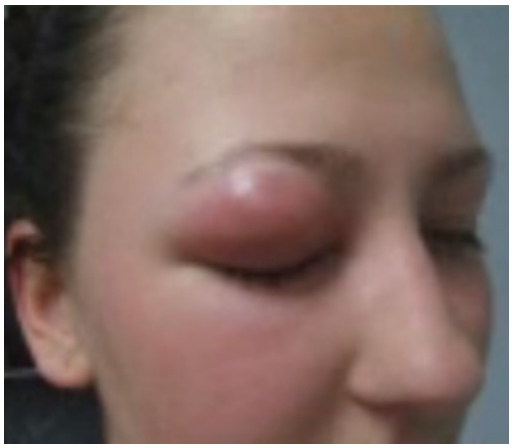


Figure 22: Emergency room case

Figure 22 is a case that a colleague sent me. This patient was seen in the emergency room two days previously. I think you might notice that the patient has a problem with her lid. Nothing really notable in her medical history, except that she is allergic to augmentin, which I find interesting because she is not allergic to penicillin. Amoxicillin is what augmentin is made of, so I think the patient probably just had GI upset or some other reaction to augmentin, and is not truly allergic to it. But the patient says she is allergic to it. VA's are normal, pupils are normal, confrontation visual fields are full, and EOM's are full and unrestricted. This leads us to believe that this is a what?

Preseptal, due to lack of ocular involvement. The doctor was concerned about this lesion so they did do a CT scan and it came back normal.

16. Now, what are you going to treat it with?
    a. Augmentin 875 mg BID po
    b. Ceftriaxone (Roceephin) 1 gram IM
    c. Ciprofloxacin 1 gram po
    d. Bactrim DS 1 tablet BID PO

(Scroll to next page for answer)

I actually said b and d for this one. I do think you could probably use augmentin in this case, because it's got really good tissue penetration in this case and the dosing is fine, so it may not be bad. Ceftriaxone, in this case, is how the patient was treated. They were concerned about the massiveness of the infection in her lid, so they actually gave her an IM injection of ceftriaxone and also put her on Bactrim double strength, 1 tablet every 12 hours.

Two days later she came back with no significant improvement at this point. At that point, they had a surgeon who was there who cut the lesion open and drained it. He said it looked like brain tissue – it was not a fluid, it was more like cottage cheese that they had to scoop out. At that point, he left the wound open and filled it with iodoform, which is actually betadine-soaked gauze. He then patched the wound, and added Keflex because Keflex has better absorption than Bactrim does.

At that point, they didn't know that this was actually a MRSA infection. They sent that cottage-cheese deposit out for culturing, and it came back as MRSA. Then, they took her off the Keflex and put her back on Bactrim, because Bactrim is better for MRSA than Keflex. Seven days later, she was fine.

This is a patient who was just part of the university. She was not living in a community center, she was not hospitalized. We are now seeing these MRSA infections coming out into the population in general, not necessarily restricted to community-based. If this was developed in a hospital, I would certainly treat with an eye towards MRSA. They did a study about hospital patients who were coming in, and I believe they said that of all the ocular infections that were coming in, on average anywhere between 10 and 20% of them are MRSA infections. The most common of those is a pre-septal cellulitis. The least common are corneal ulcers. Thus, if you see a pre-septal cellulitis, you need to be concerned and consider MRSA.

17. In the following bacterial infections, which would the use of sulfa be ineffective?
    a. Staph aureus
    b. Neisseria gonorrhoeae
    c. Strept pneumoniae
    d. Haemophilus influenzae

(Scroll down to see answer)

The correct answer is B. I would personally say it's ineffective for all of them, but remember that Neisseria has that hyperacute infection with that purulent discharge that definitely inactivates the sulfa. It's probably not going to be effective in any of the options, but definitely will not work for Neisseria.

Inhibitors of Cell Membrane Function

These are your tuberculosis meds, and they are only used for tuberculosis. The scary part about tuberculosis is that often the treatment does not cure the condition, so they will be on a drug like Isoniazid for 6 to 9 months, then they need to be switched to something else.

I only throw this in here because you need to know when patients are on these medications, but you will not be prescribing them. Patients may come in from foreign countries, and a lot of times they are put on Isoniazid as a prophylactic treatment for tuberculosis. So you may see it in practice, though you will not actually prescribe it.

Thank you very much for your time and attention.

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