Challenge M242-2

August 2024

Ear - *Pseudomonas aeruginosa*

HISTORY

A simulated ear swab sample collected from a 65-year-old diabetic with ear redness and pain was sent to category A laboratories. Participants were expected to isolate and report *Pseudomonas aeruginosa* and report susceptibility results.

CMPT QA/QC/STATISTICS

All simulated ear swab samples are produced at CMPT according to CMPT internal protocols. The sample contained a pure culture of Pseudomonas aeruginosa.

The samples are assessed for homogeneity and stability using in-house quality control methods and random selection of samples before and during production, and post sample delivery. The number of random samples selected is 15% of the total production batch.

The challenge sample lot was confirmed to be homogeneous and stable for 14 days.

Organism identification was confirmed by a reference laboratory.

All challenge components have in-house assigned values based on the most clinically appropriate result; the most clinically appropriate result is determined by expert committee evaluation. No further statistical analysis is performed on the results beyond that described under "Suitability for grading."

SURVEY RESULTS

Reference laboratories

Identification: 13/13 (100%) labs reported *Pseudomonas aeruginosa*

Susceptibility: 13/13 (100%) labs reported the isolate susceptible to ceftazidime and ciprofloxacin; 12/13 (92%) labs reported it susceptible to piperacillin/tazobactam; 11/13 (85%) reported it susceptible to tobramycin.

Participants

Identification: 49/50 (98%) participants reported *P. aeruginosa*. One laboratory also reported the presence of coagulase-negative *Staphylococcus* species (Table 1).

MAIN EDUCATIONAL POINTS from M242-2

1. Recognizing P. aeruginosa causes, a wide range of infections, and external otitis is a mild external ear infection which can commonly occur in both healthy and immune compromised individuals.
2. The importance of fully identifying isolates causing infection and ensuring they are differentiated from other closely associated bacteria.
3. It is important to perform a wide range of appropriate antimicrobial sensitivity testing given the rise of antimicrobial resistant cases, allowing facilities to monitor resistance and track possible transmission.

Susceptibility: 47/50 (94%) labs reported the strain susceptible to ceftazidime and ciprofloxacin; 43/50 (86%) reported it susceptible to piperacillin/tazobactam; 39/50 (78%) reported it susceptible to tobramycin (Table 2A-D))

Suitability for Grading

A challenge is considered suitable for grading if agreement is reached by 80 percent of selected reference group and at least 50 percent of the participants.

Organism identification was correctly performed by at least 80 percent of reference laboratories and greater than 50 percent of all laboratories and was thus, determined to be suitable for grading.

Grading

Maximum grade: 20

Reporting *P. aeruginosa* was graded 4.

Reporting the organism susceptible to ciprofloxacin, ceftazidime, piperacillin-tazobactam, and tobramycin was graded 4 for each correctly reported agent.

Table 1. Identification results

Reported	Total	Grade
Pseudomonas aeruginosa	49	4
Pseudomonas aeruginosa, coagulase-negative *Staphylococcus* species	1	3
sample not normally processed	1	ungraded
Total	**51**	

COMMENTS ON RESULTS

The expectation of this simulation was the successful recovery of *Pseudomonas aeruginosa* and thereafter appropriate susceptibilities according to their standard operating procedures.

All the submitting reference laboratories successfully identified and reported *P. aeruginosa* (13/13) and most participant laboratories successfully identified and reported *P. aeruginosa* (49/51). A single participant laboratory reported *P. aeruginosa*, coagulase-negative staphylococcus species; given the culture sent was pure, they received a grade of 3.

In this instance this was a highly susceptible strain of *Pseudomonas*. Most participant laboratories reported ceftazidime as sensitive (47/51), two laboratories provided no report and received a grade of 0 and two laboratories did not perform the testing and were therefore ungraded.

For ciprofloxacin most laboratories reported it as sensitive (47/51) and 3 provided no reported and received a grade of 0. For piperacillin-tazobactam, most laboratories reported it as sensitive (42/51), a single laboratory reported piperacillin sensitive, which received a score of 3, given this antibiotic is not available so it should not be reported. A total of 6 labs provided no report and received a grade of 0 and two laboratories did not perform the testing and were therefore ungraded.

Tobramycin is active against aerobic gram-negative bacteria, including *Pseudomonas* and is commonly prescribed for treatment of both superficial and deep infections. Most laboratories reported tobramycin as sensitive (39/51), a total of 11 provided no report and received a grade of 0 and a single laboratory did not perform the testing and were therefore ungraded

Pseudomonas aeruginosa can colonize the gastrointestinal tract, the upper respiratory mucosa, and moist skin areas of hospitalized patients who have received broad spectrum antibiotics. Community infections include superficial skin and ear infections, malignant otitis externa, eye infections (often contact lens associated), osteomyelitis, and endocarditis (intravenous drug users). This case was clearly identified as a community patient with diabetes as a clinical factor.

ISOLATION AND IDENTIFICATION

Pseudomonas species are aerobic, non-spore forming, gram negative bacilli that are straight or slightly curved. They are usually motile and possess a strictly aerobic respiratory metabolism. Most species of clinical interest are oxidase-positive and catalase-positive.

Pseudomonas aeruginosa is distinct from the rest of the clinically relevant fluorescent pseudomonads, including *Pseudomonas fluorescens*, in its ability to grow at 42°C. In addition to pigment production, other tests that confirm the identification of *P. aeruginosa* include a positive arginine test and an alkaline reaction in a triple-sugar-iron agar slant. [1]

Table 2. Susceptibility results

2A Ceftazidime	**Total**	**Grade**
S	47	4
no report	2	0
not available for testing	1	ungraded
sample not normally processed	1	ungraded
Total	**51**	
2B Ciprofloxacin	**Total**	**Grade**
S	47	4
no report	3	0
Total	**51**	
2C Piperacillin-Tazobactam	**Total**	**Grade**
S	42	4
Piperacillin S	1	3
no report	6	0
not available for testing	1	ungraded
sample not normally processed	1	ungraded
Total	**51**	
2D Tobramycin	**Total**	**Grade**
S	39	4
no report	11	0
sample not normally processed	1	ungraded
Total	**51**	

Because of its distinctive colony characteristics, *P. aeruginosa* can be identified with few biochemical tests. Oxidase-positive colonies of a gram-negative bacilli displaying the typical grape-like smell and recognizable colony morphology (metallic, rough, and pigmented) are *P. aeruginosa*. [2]

CLINICAL RELEVANCE

Otitis externa is infection of the external auditory canal and may be subdivided into four categories: acute localized otitis externa, acute diffuse otitis externa ("swimmer's ear"), chronic otitis externa, and malignant (invasive) otitis externa. [4–6]

Bacteria cause 98% of otitis externa; the two most common pathogens are *Pseudomonas aeruginosa* and *Staphylococcus aureus*. [4,7] *Staphylococcus aureus is most commonly associated with* acute localized otitis externa while *Pseudomonas aeruginosa* is most frequently associated with acute diffuse otitis externa and malignant otitis externa. [4]

Pseudomonas aeruginosa is a prevalent environmental organism; it is not a component of normal human skin flora. *Pseudomonas aeruginosa* is ubiquitous in water and may colonize the external ear canal in moist and humid conditions and subsequently cause a localized infection termed acute diffuse otitis externa.

Acute diffuse otitis externa normally responds to topical antimicrobials in the form of otic drops, which may be delivered in combination with corticosteroid drops. [4]

Malignant otitis externa, in contrast to acute diffuse otitis externa, is an aggressive and severe form of otitis externa that may progress to be life-threatening. It typically starts superficially and spreads contiguously to deeper tissues and can invade underlying blood vessels, cartilage and bone. Nearby critical structures, such as the cranial nerves and the jugular bulb, may be affected.

Risk factors for malignant otitis externa include advanced age, immunosuppression, and diabetes mellitus. Clinically, it manifests with severe ear pain, and may be accompanied by purulent drainage from the ear.

A prolonged course of systemic antimicrobials is the mainstay of therapy for this infection, and therapy should be directed by antimicrobial susceptibility testing. Surgical debridement of necrotic or devitalized tissue and drainage of any associated abscess may be necessary.

REFERENCES

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