Challenge M234-4

February 2024

Liver abscess: *Klebsiella pneumoniae*

HISTORY

A simulated liver abscess sample collected from a 45 year old in-patient with abdominal pain was sent to category A laboratories.

Participants were expected to isolate and report *Klebsiella pneumoniae* and report susceptibility results.

CMPT QA/QC/STATISTICS

All simulated abscess samples are produced at CMPT according to CMPT internal protocols. The sample contained a pure culture of *Klebsiella pneumoniae*

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 17 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: 12/12 (100%) labs reported *K.pneumoniae* ± ssp pneumoniae (Table 1).

Susceptibility: 12/12 (100%) labs reported ampicillin R, 1/12 labs reported cefazolin R, 8/12 labs reported cefazolin S, 3 labs did not report; 7/12 labs reported ceftriaxone or cefotaxime S, 5 labs did not report; 10/12 (83%) labs reported ciprofloxacin S, 2 labs did not report; 11/12 (92%) labs reported gentamicin/tobramycin S, 1 lab did not report; 10/12 (83%) labs reported SXT S, 1 lab reported SXT I, 1 lab indicated it would refer. 1 reference lab does not process this type of sample.

MAIN EDUCATIONAL POINTS from M234-4

1. *Klebsiella pneumoniae* is a common infectious agent in walled-off intra-abdominal abscesses. It is often polymicrobial with an anaerobic component as well, which complicates treatment.
2. Hospitalization, drainage, and significant antimicrobial therapy often with at least two susceptible agents is important.
3. It is important even with a susceptible strain of *Klebsiella*, as included in this challenge, to first report ampicillin as resistant, and to report other agents that are effective with good tissue penetration in serious infections so the clinician has useful options for treatment.

Participants

Identification: 51/51 (100%) labs reported *K.pneumoniae* ± ssp pneumoniae, 1 lab indicated it does not normally process the sample (Table 1).

Susceptibility: 49/51 (96%) labs reported ampicillin R, 1/51 labs reported cefazolin R, 32/51 labs reported cefazolin S, 18 labs did not report; 33/51 labs reported ceftriaxone or cefotaxime S, 5 labs did not report; 10/12 (83%) labs reported ciprofloxacin S, 2 labs did not report; 16/51 (92%) labs reported gentamicin/tobramycin S, 1 lab did not report; 10/12 (83%) labs reported SXT S, 1 lab reported I, 1 lab indicated it would refer (Table 2).

Grading

Maximum grade: 20

Reporting *Klebsiella pneumoniae* was graded 4.

Reporting the organism resistant to ampicillin and susceptible to ciprofloxacin, gentamicin/tobramycin, and SXT was graded 4 for each antimicrobial agent.

Table 1. Identification results

Reported	Total	Grade
Klebsiella pneumoniae ± ssp pneumoniae ± refer ± complex	51	4
Microbiology temporarily deferred to regional lab due to staffing shortage.	1	ungraded
sample not normally processed	2	ungraded
Total	**54**	

Table 2. Susceptibility results

2A - Ampicillin	Total	Grade
R	49	4
no report	2	0
refer, sample not normally processed	3	ungraded
Total	**54**	
2B - Cefazolin	**Total**	**Grade**
R	1	ungraded
S	32	ungraded
no report	18	ungraded
refer, sample not normally processed	3	ungraded
Total	**54**	
2C - 3rd gen cephalosporins	**Total**	**Grade**
S	33	ungraded
no report	16	ungraded
refer, sample not normally processed	5	ungraded
Total	**54**	
2D - Ciprofloxacin	**Total**	**Grade**
S	45	4
no report	6	0
refer, sample not normally processed	3	ungraded
Total	**54**	
2E - Gentamicin/Tobramycin	**Total**	**Grade**
S (Gen n=45 Tob n=4)	49	4
no report	2	0
refer, sample not normally processed	3	ungraded
Total	**54**	
SXT	**Total**	**Grade**
S	46	4
I	1	3
no report	3	0
refer, sample not normally processed	4	ungraded
Total	**54**	

COMMENTS ON RESULTS

This challenge was meant to be recovered from a patient with a serious infection with *Klebsiella pneumoniae* that requires hospitalization, drainage of the abscess and significant antimicrobial therapy, usually associate with multiple antimicrobials to ensure successful resolution of the infection.

The identification of the causal microorganims was performed correctly by all the laboratories. *Klebsiella* is not difficult to identify and with automated or manual systems can result in correct identification. Mucoid and lactose fermentation on MacConkey agar often is a good clue.

This was a very susceptible strain of *Klebsiella* (see Clinical Relevance below) Resistance to ampicillin is considered intrinsic as greater that 95% of strains will test as resistant, but it is important to report that result so that clinicians should not be tempted to use ampicillin even if not reported. For cefazolin, there was such a divergence of results that the test was not graded. Isolates are often susceptible, but inhibition and killing of *Klebsiella* can be slower with cefazolin in deep walled-off infections.

In this type of infection, most clinicians would utilize a parenteral third generation cephalosporin (or carbapenem -if susceptible), rather than sulfamethoxazole- trimethoprim. Other antimicrobial agents that may be utilized whether susceptible of resistant should be reported so the attending physician is clear about their susceptibility and efficacy.

ANTIMICROBIAL SUSCEPTIBILITY

K. pneumoniae is considered intrinsically resistant to ampicillin, over 95 % of strains will test resistant to this agent.

Despite emerging antimicrobial resistance in *Klebsiella pneumoniae* as discussed above, most isolates in the community remain susceptible to third-generation cephalosporins, carbapenems, aminoglycosides, trimethoprim-sulfamethoxazole and fluoroquinolones.

CLINICAL RELEVANCE

First noted in the mid-1980s, a distinct invasive syndrome of monomicrobial *Klebsiella pneumoniae* causing pyogenic liver abscesses was identified and has emerged as a global disease.[1,2]

K. pneumoniae liver abscess is more prevalent in parts of Asia, accounting for 80% of all cases of pyogenic liver abscess in Taiwan and Korea, and has been reported sporadically elsewhere in Asia, North America, Europe, and Australia.[1,3,4]

Infections are primarily caused by hypermucoid strains of *K. pneumoniae* of the capsular K1 (or occasionally K2) serotype also associated to hypervirulence. These strains have become more common around Asia, have community origin and can often cause infection in even healthy and immunocompetent people.[2,5]

Diabetes mellitus (DM) is believed to be one of the risk factors of *K. pneumoniae* liver abscess;[6] DM was present in up to 63% of cases in a Taiwanese study compared to 5-33% of non-*K. pneumoniae* cases.[7,8]

Although the mortality rate for *K. pneumoniae* liver abscess is similar to that of approximately non-*K. pneumoniae* liver abscess (5%), metastatic infections, such as endophthalmitis and meningitis, have been reported in approximately 10-16% of cases [9] therefore a *K. pneumoniae* isolate taken from a blood or liver abscess with the hypermucoviscous phenotype is suggestive of an invasive *K. pneumoniae* strain, and the attending clinician should be notified as soon as possible.[1]

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