Diagnostic Utility of a Multiplex PCR Meningitis/Encephalitis Panel and Impact on Antibiotic Use

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INTRODUCTION

Meningitis and encephalitis can be caused by a variety of pathogens with the most common being viral. As neurological sequelae of meningitis and encephalitis can be devastating, prompt diagnosis and treatment are imperative. Unfortunately, traditional methods for pathogen detection and CSF analysis may take several hours to days, resulting in unnecessary antibiotic use in the interim. The BioFire FilmArray Meningitis/Encephalitis Panel is a multiplex PCR system that simultaneously detects 14 pathogens in one hour. This Panel was FDA approved in 2015 and adopted by our institution in June 2017. The purpose of this project was to assess the impact of this Panel on antibiotic use.

METHODS

We conducted a retrospective cohort study of 222 patients diagnosed with meningitis/encephalitis since 2015. Patients were divided into two cohorts: those in whom the Panel was used and those in whom the Panel was not used. "Duration of antibiotic use" was defined as the length of time (in calendar days) that patients received antibiotics after interpretation of PCR results. "Suspected etiology" was based on results of CSF analysis (protein, glucose, leukocytes) along with manual chart review to determine which pathogen was suspected by the treatment team.

The "Panel" cohort consisted of 72 patients and the "Non-Panel" cohort of 150. As all patients were included to maximize sample size, some disparities were noted between cohorts, as follows:

Variable	Panel	Non-Panel	p-value
Age (*years*)	54.1	46.9	0.048
Sex: Female	69.4%	55.3%	0.045
Diabetes	26.4%	15.3%	0.049

RESULTS

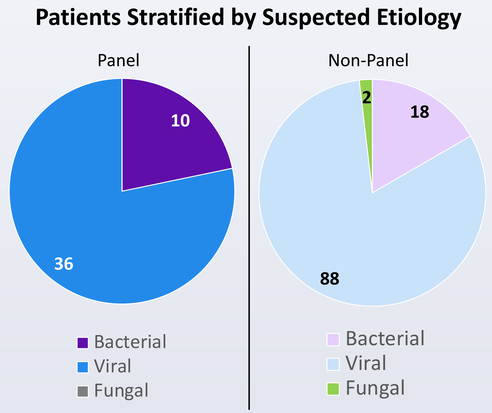

Figure 1: Number of patients in the two cohorts divided by the suspected etiology of infection. Only two patients had fungal meningitis, both in the non-panel cohort.

Variable	Panel (n = 72)	Non-Panel (n = 150)	p-value
Length of Stay (*days*)	13.5	11.9	0.448
Zero Days of Antibiotics	88.9%	88.7%	0.961
Pathogen Identified	33.3%	37.3%	0.561
Breakdown of Identified Pathogens			
S. pneumoniae	2.78% (*n = 2*)	4.00% (*n = 6*)	0.647
H. influenzae	1.39% (*n = 1*)	0.67% (*n = 1*)	0.594
S. agalactiae (GBS)	2.78% (*n = 2*)	1.33% (*n = 2*)	0.449
L. monocytogenes	1.39% (*n = 1*)	0.67% (*n = 1*)	0.594
Enterovirus	4.17% (*n = 3*)	12.00% (*n = 18*)	0.062
Herpes Simplex 1 (HSV1)	5.56% (*n = 4*)	6.67% (*n = 10*)	0.750
Herpes Simplex 2 (HSV2)	6.94% (*n = 5*)	5.33% (*n = 8*)	0.632
Varicella Zoster (VZV)	5.56% (*n = 4*)	5.33% (*n = 8*)	0.945
Human Herpesvirus 6	1.39% (*n = 1*)	0% (*n = 0*)	0.148
C. neoformans/C. gattii	0% (*n = 0*)	1.33% (*n = 2*)	0.325

Table 1: Comparison of additional outcome measures.

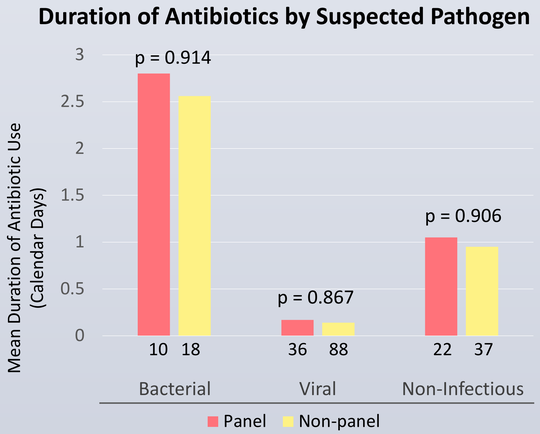

Figure 2: Antibiotic use stratified by suspected infectious etiology. The number of patients per group are shown beneath the corresponding bar.

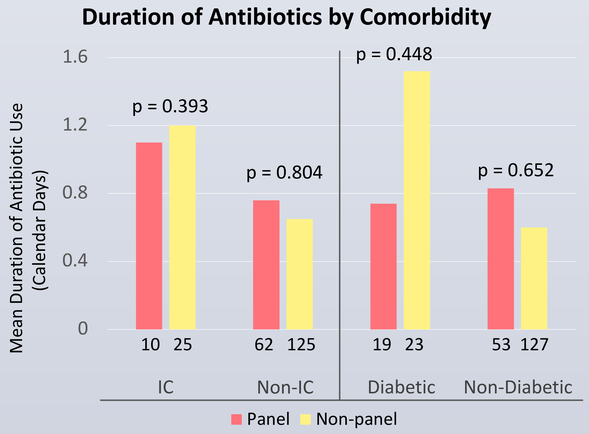

Figure 3: Antibiotic use stratified by immunocompromised (IC) & diabetes. The number of patients per group are shown beneath the corresponding bar.

DISCUSSION

Of all suspected infectious etiologies, viral was most commonly suspected (55.9%) and identified (27.5%). Overall a pathogen was identified in fewer than 40% of all cases. The distribution of pathogens was statistically comparable in both cohorts (Table 1), though in the non-panel group there was a trend towards more enteroviruses identified. Only two patients were diagnosed with *Cryptococcal* meningitis, both of whom were in the Non-Panel cohort. A non-infectious etiology was found in 26.6% of patients.

Despite a more rapid result, patients in the Panel cohort did not have a shorter mean length of stay (13.5 vs. 11.9 days, p = 0.448). Mean duration of antibiotic use was comparable in bacterial (2.80 vs. 2.56 days, p = 0.914), viral (0.17 vs. 0.14 days, p = 0.867), and non-infectious (1.05 vs. 0.95 days, p = 0.906) cases. Immunocompromised (1.10 vs. 1.20 days, p = 0.393) and diabetic (0.74 vs. 1.52 days, p = 0.448) patients also had similar durations of antibiotic use in both cohorts. Notably, the Panel cohort was older (54.1 vs. 46.9 years, p = 0.048) with a greater proportion of diabetic patients (69.4% vs. 55.3%, p = 0.045).

CONCLUSION

At our institution, the BioFire Panel did not significantly reduce length of stay or duration of antibiotic use; however, the studied cohorts were not matched in terms of age and comorbidity. Studies analyzing the quantity of antibiotics administered or the overall cost of diagnostic testing performed may provide a more complete picture regarding the clinical utility of this tool.

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