

Things We Do for No Reason™: Lumbar Punctures in Low-Risk Febrile Infants with Bronchiolitis

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Inspired by the ABIM Foundation's Choosing Wisely® campaign, the "Things We Do for No Reason™" (TWDFNR) series reviews practices that have become common parts of hospital care but may provide little value to our patients. Practices reviewed in the TWDFNR series do not represent "black and white" conclusions or clinical practice standards but are meant as a starting place for research and active discussions among hospitalists and patients. We invite you to be part of that discussion.

CLINICAL SCENARIO

A 22-day-old full-term previously healthy male infant was evaluated in the emergency department (ED). The patient's mother reported a three-day history of nasal congestion, cough and labored breathing, decreased oral intake, and subjective fever.

In the ED, the patient was found to have a rectal temperature of 101.3 °F (38.3 °C), heart rate of 112 beats per minute, and a respiratory rate of 54 breaths per minute, with subcostal retractions and diffuse expiratory wheezing. His appearance was otherwise unremarkable. His evaluation in the ED included a normal complete blood count (CBC) with differential, a normal urinalysis, and a chest radiograph with diffuse peribronchial thickening. Blood and catheterized urine cultures were also collected. The patient's provider informs the parents that a lumbar puncture (LP) would be performed to rule out bacterial meningitis. Is it necessary for this patient to receive an LP?

INTRODUCTION

Fever in an infant <90 days old is a common clinical presentation.¹ Because a newborn's immune system is still developing, there is a heightened concern for bacterial infections in this age group. These include bloodstream infections, meningitis, pneumonia, urinary tract infections (UTIs), skin/soft tissue infections, and osteoarticular infections. Bacterial infections collectively account for approximately 10% of illness in young febrile infants <90 days.² Of these, UTIs are the most common. The most recent literature has narrowed the focus on infants <60 days old as the risk of serious infection is inversely correlated with age. Meningitis accounts for 1% of infections or less in children <60 days of age who present with a fever.³

Frequently, the evaluation of fever in young infants leads to cerebrospinal fluid (CSF) collection and hospitalization.⁴ Among febrile infants, current practice patterns regarding LPs vary across institutions.⁵ Some clinical practice guidelines recommend universal CSF testing for all febrile infants ≤56 days old.⁶

Bronchiolitis is also a common presentation. Up to 90% of children are infected with respiratory syncytial virus, the most common viral cause of bronchiolitis, within the first two years of life.⁷ Fever may be a presenting symptom in infants with bronchiolitis and one study found approximately 11% of febrile infants less than 90 days old met clinical criteria for bronchiolitis.⁸

WHY YOU MIGHT THINK LUMBAR PUNCTURE IN FEBRILE INFANTS WITH BRONCHIOLITIS IS HELPFUL

While clinical guidelines for bronchiolitis are well established,⁷ the evaluation and management of fever in an infant <90 days old remains a challenge because of concern for missing a bloodstream infection or meningitis. Meningitis can devastate an infant neurologically.⁹ Signs and symptoms of bacterial meningitis in infants are not specific, including the physical exam.¹⁰ Blood cultures are only concomitantly positive in 62% of cases of culture-confirmed bacterial meningitis.¹¹

Several risk stratification algorithms exist to evaluate the likelihood of bacterial infections in febrile infants (Table). Two of the most common criteria—the Boston and Philadelphia—were validated using CSF cell count data. Other algorithms do not require an LP.¹²⁻¹⁵ All of the fever criteria algorithms have several limitations including lack of robust validation studies, under-powered methodologies (particularly for meningitis), and different inclusion criteria.² Even with these risk stratification algorithms, some providers may continue to feel more comfortable obtaining CSF due to fear of missing meningitis in well-appearing, low-risk infants.

WHY LUMBAR PUNCTURE IN LOW-RISK FEBRILE INFANTS WITH BRONCHIOLITIS IS NOT NECESSARY

Bacterial meningitis, even in young infants, is rare. A recent meta-analysis estimated the general prevalence of meningitis in febrile neonates (regardless of risk stratification or bronchiolitis symptoms) in their first and second months of life were 1.2% (95% CI, 0.8%-1.9%) and 0.4% (95% CI, 0.2%-1.0%), respectively.³

Febrile infant risk stratification algorithms have high negative predictive values (NPVs) in ruling out meningitis. The Rochester criteria, which does not utilize CSF, has an NPV of greater

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TABLE 1. A Comparison of Risk Stratification Algorithms for Febrile Infants <60 Days of Age without the Requirement for Lumbar Puncture^a

		Rochester ¹²	Modified Philidelphia ¹³	Lab-score ¹⁴	PECARN ¹⁵
Age		<60 d	<60 d	7-90 d	<60 d
Validation Population Size		1057	135 (case control)	408	913 (internal validation)
Temperature (°F)		>38.0	>38.2	>38.0	>38.0
Labs (to determine low-risk for bacterial infection)	CBC	WBC > 5K	WBC < 15K	None	ANC < 4090/μL
		WBC < 15K	Band/N ratio <0.2		
		Abs band < 1500/μL			
	UA	<10 WBC/hpf	<10 WBC/hpf	Negative Leukocyte esterase and nitrites	<5 WBC/hpf Negative Leukocyte esterase and nitrite
	CSF	N/A			
Other		CXR: No infiltrate	PCT < 0.5 ng/mL CRP <40 mg/L	PCT < 1.71 ng/mL	
Reported Performance	Sens.	92%	92%	86%	98%
	Spec.	50%	35%	83%	60%
	PPV	12%			
	NPV	98.9%			99.6%

^aAll of the included criteria in a column must be met to be considered "low risk."

Abbreviations: ANC, absolute neutrophil count; Band/N, band/neutrophil; CBC, complete blood count; HPF, high power field; CRP, C-reactive protein; CSF, cerebrospinal fluid; CXR, chest X-ray; NPV, negative predictive value; PCT, procalcitonin; PPV, positive predictive value; Sens.-sensitivity; Spec.-specificity; UA, urinalysis; WBC, white blood count.

than 98%.¹² A recent Pediatric Emergency Care Applied Research Network Clinical Prediction Rule has an NPV of 99.9% among febrile infants <60 days, using only absolute neutrophil count, urinalysis, and procalcitonin.¹⁵

Among the patients that are already a low risk, concomitant viral infections further decrease the pretest probability. Febrile infants with lab-confirmed respiratory viral infections are at lower risk for serious bacterial infections.^{16,17} Multiple retrospective and prospective observational studies have demonstrated that low-risk patients with bronchiolitis symptoms are extremely unlikely to have bacterial meningitis.^{8,18-22} A systematic review of 1749 febrile patients under 90 days of age with clinical bronchiolitis demonstrated no cases of meningitis.²³ Many of these studies included infants aged <28 days. Though the total number of neonates (<28 days) in all studies is somewhat unclear, it suggests that the cut-off to avoid an LP may be even lower.

Recent literature has advocated outpatient observation without an LP for low-risk infants as a cost-effective management tool,²⁴ and this is particularly true in patients with concomitant viral bronchiolitis.

Based on the latest data confirming the low prevalence of meningitis among all infants,³ the ability to identify low-risk infants based on risk stratification algorithms (Table 1), and the decreased prevalence of meningitis in patients with clinical bronchiolitis,²³ low-risk infants with bronchiolitis seem to have minimal, if any, risk of meningitis. Therefore, low-risk infants with bronchiolitis do not warrant an LP.

Importantly, LPs are not risk neutral. Their benefit versus harm should be weighed every time they are considered. Approximately 19% of LP attempts in infants under 90 days old are either traumatic or unsuccessful.²⁵ Infants aged 28 to 60 days with traumatic or unsuccessful LPs are more frequently hospitalized.²⁵ Increased hospitalizations are associated with higher costs.⁴ The majority of positive CSF cultures are deemed to be "contaminants" (87% in one study²⁶), but the positive result still leads to unnecessary further evaluation, hospitalization, repeated invasive procedures, and family distress.²⁷ These data further support refraining from pursuing an LP in low-risk infants with bronchiolitis.

WHY LUMBAR PUNCTURE MIGHT BE HELPFUL IN CERTAIN CIRCUMSTANCES

If the patient is not low risk based on criteria or does not have clinical bronchiolitis, consider performing an LP. A recent study demonstrated a 0.4% incidence of bacterial meningitis in febrile infants with viral co-infection,²⁹ though it is not determined if the patients presented with symptoms of bronchiolitis or were risk-stratified using the algorithms discussed.

In the studies looking at viral infections in febrile infants, each has important exclusion criteria including prematurity, comorbidities, and recent antibiotic administration.²³ For these patients, an LP may be warranted (though the evidence is lacking). In addition, in very young infants (less than seven-14 days old), viral infections may be less common than in older infants,

resulting in a desire to rule out bacterial infections more thoroughly in this population.

WHAT YOU SHOULD DO INSTEAD: AVOID AN LP IN LOW-RISK FEBRILE INFANTS WITH BRONCHIOLITIS

For low-risk febrile infants with signs of bronchiolitis, evaluation for bacterial meningitis is not necessary. The low prevalence of meningitis in this age range along with the even lower likelihood of meningitis when bronchiolitis is identified suggests that the procedure is unnecessary. Moreover, the risks associated with LP—including trauma, hospitalization, costs, and family stress—likely outweigh the benefits of CSF analysis.

RECOMMENDATIONS

- In febrile infants, determine the risk of serious bacterial infections using published algorithms (Table) before considering lumbar puncture.
- In low-risk febrile infants with typical bronchiolitis, evaluation for bacterial meningitis with an LP is not necessary.

CONCLUSION

Infants under 90 days of age often present to care with fever. While there is a concern for missing bacterial meningitis, the prevalence of such an infection in infants is very low. Moreover, in low-risk patients that present with typical bronchiolitis symptoms, the prevalence is effectively zero. LP practices vary by institution and can be associated with risks. In low-risk infants with typical bronchiolitis symptoms, an LP is one of the Things We Do for No Reason™.

Do you think this is a low-value practice? Is this truly a “Thing We Do for No Reason”™? Share what you do in your practice and join in the conversation online by retweeting it on Twitter (#TWDFNR) and liking it on Facebook. We invite you to propose ideas for other “Things We Do for No Reason”™ topics by emailing TWDFNR@hospitalmedicine.org.

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