



FEVER

Represents ~20% of all encounters in ER setting

Young infants have historically been placed in a different category

Most of these kids do fine

So why the extensive work up?

Osman O et al. Health Bull 2002

2

weeks Full septic w/u if <6 weeks Full septic w/u if <4 weeks * 3 of these attendings will move this to <4 weeks if there is a viral source * n=9 67% 22% 11%

13. 14 Among pediatric emergency departments across the US, does the management of febrile infants <28 days old vary from recommended clinical guidelines? Retrospective cohort study; 36 different children's hospitals Jain S et al. Pediatrics 2014 41,890 neonates evaluated; 2253 had fever Records reviewed for compliance with recommended testing (blood, urine CSF), treatment (Amp + Gent/3rd gen cep), management (labs, treatment, admission)

- received recommended testing received recommended treatment received recommended management
15. 16 Jain S et al. Pediatrics 2014
 16. 17 Aronson PL et al. Pediatrics 2014 Retrospective cohort study of febrile infants < 90 days old 37 Pediatric EDs Assessed variation in testing, treatment, and disposition for kids in 3 distinct age groups: <28 days, 29-56, and 57-89 days 35,070 ED visits met inclusion criteria
 17. 18 13% 49% 72% Aronson PL et al. Pediatrics 2014 Neonates <28 days Infants 29-56 days Infants 57-89 days Percentage of febrile neonates/young infants receiving full septic workup
 18. 19 Aronson PL et al. Pediatrics 2014 URINE BLOOD CSF ADMIT URINE BLOOD CSF ADMIT BLOOD CSF ADMIT URINE BLOOD CSF ADMIT URINE
 19. 20
 20. 21
 21. 22
 22. 23
 23. 24 32% of meningitis is gram negative 39% of meningitis is GBS For kids under 2 months
 24. 25 Incidence of Group B Streptococcal (GBS) disease (1990-2008)
 25. 26 1/100% 1/5% 1% 5% 10% Prevalence of Serious Bacterial Infection (SBI) by Age age(days) 0-14 14-28 28-60 28-60 Percent Chance of SBI (well appearing febrile neonate/infant) >60 pre vax post vax
 26. 27 Viruses UTI Other bacterial infections (gastro, cellulitis, osteo, pneumonia) Bacteremia Meningitis
 27. 28 33% 67% Everything else Urinary tract infections Bacterial Infections in Infants < 3 months Brown LA. Crit Decis Emerg Med 2000
 28. 29 Low Risk Criteria 2
 29. 30 Baker et al. New England Journal of Medicine 1993 Clinical scoring systems in neonates and young infants are NOT reliable to rule-out serious bacterial infection (SBI) 2/3 with bacterial infections "appeared well" to attending
 30. 31 Sensitivity of Observation, History, and Exam in Detecting Serious Illnesses McCarthy P. Pediatrics in Review. 1998
 31. 32 Baker et al. New England Journal of Medicine 1993 474 infants 29-60 days old Low-risk kids can be managed as outpatients without antibiotics after a FULL septic workup
 32. 33 Philadelphia Age 29-60 Exam Well-appearing No focal infection Labs CSF <8, CSF gram stain neg, WBC < 15, Band-neutrophil ratio <0.2, UA <10 WBC/hpf, CXR neg, Stool neg High risk Hospitalize + empiric abx Low risk Home, no abx, f/u within 24 hours Baker et al. New England Journal of Medicine 1993
 33. 34 Baker et al. New England Journal of Medicine 1993 Sensitivity 98% Specificity 50% Positive predictive value 12.3% Negative predictive value 99.7%
 34. 35 When Thinking About Predictive Value of a Test... Imagine you are the patient receiving test results of a screening test If the test is POSITIVE, How likely is it that you really have the disease? How worried should you be? If the test is NEGATIVE, How likely is it that you really don't have the disease? How reassured should you be?
 35. 36 NPV Sensitivity Band:neutrophil Baker et al. New England Journal of Medicine 1993
 36. 37 Baskin et al. J Pediatr 1992 Looked at 503 febrile infants (1-3 months old) Gave Rocephin after meeting specific low-risk criteria Specificity 94.6% 27/503 (5.4%) had SBI
 37. 38 Boston Criteria Age 28-89 d Hx No immunizations in preceding 48 hours No antibiotics within 48 hours Exam Well-appearing No focal infection Labs WBC <20, CSF <10, UA <10 WBC/hpf, CXR: no infiltrate High risk Hospitalize + empiric abx Low risk Home, Rocephin, F/u within 24 hours Baskin et al. J Pediatr 1992
 38. 39 Specificity Rocephin Baskin et al. J Pediatr 1992 NPV
 39. 40 Looked at 931 well appearing infants <60 days old Found SBI in 5 of 437 (1%) febrile neonates who met low-risk criteria Sensitivity 92%, NPV 98.9% Jaskiewicz JA et al. Pediatrics 1994
 40. 41 Rochester Age <60 Hx Term No perinatal abx No underlying disease Exam Well-appearing No focal infection Labs

- WBC >5000 and <15,000 Absolute band count <1500 UA <10 WBC/hpf <5 WBC/hpf stool smear High risk Hospitalize + empiric antibiotics Low risk Home, no abs, f/u within 24 hours Jaskiewicz JA et al. Pediatrics 1994
41. 42 NPV No Rocephin Jaskiewicz JA et al. Pediatrics 1994
42. 43 Boston Philadelphia Rochester Age 28-89 d 29-60 <60 Hx No immunizations in preceding 48 hours No antibiotics within 48 hours Term No perinatal abx No underlying disease Exam Well-appearing No focal infection Well-appearing No focal infection Well-appearing No focal infection Labs CSF <10 UA <10 WBC/hpf CXR: no infiltrate WBC <20,000 CSF <8 CSF gram stain neg WBC < 15,000 Band-neutrophil ratio <0.2 UA <10 WBC/hpf CXR neg Stool neg WBC >5000 and <15,000 Absolute band count <1500 UA <10 WBC/hpf <5 WBC/hpf stool smear High risk Hospitalize + empiric abx Hospitalize + empiric abx Hospitalize + empiric antibiotics Low risk Home, Rocephin, F/u within 24 hours Home, no abx, f/u within 24 hours Home, no abx, f/u within 24 hours
43. 44 Cincinnati Children's Evidence-Based Care Guideline 2010 (infants 29-60 days old)
44. 45 Huppler et al. Pediatrics 2010 Meta-analysis of 21 studies looking at low-risk criteria for febrile infants <90 days old Rate of SBI in low-risk patients in all studies was 2.23% The rate of low-risk patients in prospective studies without empiric antibiotics (variations of Rochester criteria) was significantly different: 0.67%
45. 46 What about WBC, CRP, and Procalcitonin?
46. 47 Estimate your pre-test probability How likely is it that this kid has a SBI based on literature and experience? What are the test's positive and negative likelihood ratios? How good is the test at telling me what I want to know? What is your post-test probability? What is the new estimate that the kid has an SBI?
47. 48 This is an estimate Each test has a +/-LR Use the nomogram
48. 49 LR+ 1-2 USELESS LR+ 2-10 MOD LR+ >10 STRONG LR- 0.5-1 USELESS LR- 0.1-0.5 MOD LR- <0.1 STRONG
49. 50 LR+ LR- LR- 0.5-1 USELESS LR- 0.1-0.5 MOD LR- <0.1 STRONG LR+ 1-2 USELESS LR+ 2-10 MOD LR+ >10 STRONG
50. 51
51. 52 LR+ LR- LR- 0.5-1 USELESS LR- 0.1-0.5 MOD LR- <0.1 STRONG LR+ 1-2 USELESS LR+ 2-10 MOD LR+ >10 STRONG
52. 53 Pre-test probability goes from: 5% to less than 0.5%
53. 54 Is WBC a good screen for bacteremia in kids 0-90 days old undergoing a full sepsis eval?
54. 55 Bonsu et al. Ann Emerg Med 2003
55. 56 Is WBC a good screening tool for febrile kids <90 days who need an LP?
56. 57 Bonsu et al. Ann Emerg Med 2003
57. 58 Maniaci V et al. Pediatrics 2008 LR- 0.5-1 USELESS LR- 0.1-0.5 MOD LR- <0.1 STRONG 234 infants 30 had SBI (12.8%) For identifying definite and possible serious bacterial infections, a cutoff value of 0.12 ng/mL had a sensitivity of 95.2%, specificity of 25.5%, negative predictive value of 96.1%, and a negative likelihood ratio of 0.19 All cases of bacteremia were identified accurately with this cutoff value
58. 59 Gomez B et al. Pediatrics 2012 1112 infants <3 months old fever without a source 23 cases of SBI (2.1%) PCT better than CRP in identifying kids with SBI LR- 0.5-1 USELESS LR- 0.1-0.5 MOD LR- <0.1 STRONG LR+ 1-2 USELESS LR+ 2-10 MOD LR+ >10 STRONG
59. 60 Bilavsky E et al. Acta Paediatrica 2009 LR- 0.5-1 USELESS LR- 0.1-0.5 MOD LR- <0.1 STRONG LR+ 1-2 USELESS LR+ 2-10 MOD LR+ >10 STRONG
60. 61 Are Procalcitonin and CRP good at detecting SBI?
61. 62 The Workup 3
62. 63
63. 64 <28 days 1-2 months >2 months
64. 65 Everyone gets blood, urine, csf+ abx + admission Viral URI sx DO NOT count as a fever source H&P are

UNRELIABLE to rule out SBI UTI (20%) >>> Bacteremia (3%) >> Meningitis (<1%) E. Coli, GBS, HSV >> Listeria, Salmonella, Staph. aureus Neonates Birth to 28 days

65. 66 Neonates will have picked up bacteria from the birth canal Herd immunity doesn't help against what mom can give you Immune system sucks Very little shield between blood/brain/urine (membranes are wide open) Neonates Birth to 28 days

66. 67

67. 68 Young Infants 29-60 days Viral sx MAY count as a fever source UTI (15%) >>> bacteremia (1%) >>> meningitis (0.2-0.4%) Invasive bacterial infection (IBI) rate 1/100 to 1/1000 E. coli, GBS, S.pneumo >>>N.meningitides, H. flu, Staph. aureus Classically: Blood, urine, CSF, +/- antibiotics, +/- admission

68. 69 Older Infants >60 days Higher threshold to prompt a work up >39 C (102.2 F) Females <24 mo: UA/UCx Uncircumcized Males <6 mo: UA/UCx; consider in <12 mo Circumcized males: consider UA/UCx in <6mo

69. 70 Odds are in your favor: physiology + vaccinations Occult bacteremia rates becoming very very low (<0.5%) False positive blood culture rate is higher than rate of occult bacteremia Physical exam is useful Older Infants >60 days

70. viral syndrome (documented/ suspected) including bronchiolitis 71 9.5% 6% 0.5% UTI Other (gastro, PNA, AOM, aseptic meningitis) Bacteremia Evaluation of 429 febrile infants 57-180 days old SBI rate 10.3% Most of which were UTI and no bacterial meningitis was diagnosed No infants, aged 2-3 months had a positive blood culture This suggests that infants 2-3 months of age perhaps can be managed less conservatively and be grouped with their older counterparts 84% presumed or documented viral illness/bronchiolitis Hsiao AL et al. Pediatrics 2006

71. 72 Lee GM et al. Pediatrics 2001 "CBC+ selective blood culture and treatment using a WBC cutoff of 15 is cost effective at the current rate (2001) of pneumococcal bacteremia. If the rate of occult bacteremia falls below 0.5% with widespread use of the conjugate pneumococcal vaccine, then strategies that use empiric testing and treatment should be eliminated"

72. 73 Looked at rate of occult bacteremia in 8408 well appearing febrile children aged 3 to 36 months: 0.25% Wilkinson M et al. Acad Emerg Med 2009

73. 74 392 febrile children aged 1-36 months retrospectively reviewed Occult bacteremia rate 0.34% Literature review identified 10 relevant studies that showed an overall bacteremia rate <1% for kids aged 3-36 months with rates <0.5% in settings with high PCV-7 coverage Bressan S et al. Acta Paediatrica 2011

74. 75 Blood culture contamination rate is around 2-3% (0.6%-6% range) Hall KK et al. Clinical Microbiology Reviews 2006

75. Di cult Clinical Scenarios 76 4

76. 77 Dry or Traumatic Tap At a minimum, cultures of blood and urine should be obtained. If the LP is traumatic, the tube in which the CSF is clearest should be sent for a cell count. Two acceptable approaches: A repeat lumbar puncture after admission, or observing the infant in the hospital o antibiotics after the cultures are negative at 48 hours

77. 78 1 : ~1000

78. 79 What About a REALLY High Fever?

79. 80 Trautner BW et al. Pediatrics 2006 Bacterial/viral coinfection Children presenting to ED with hyperpyrexia are at high risk for SBI Equally high risk for a viral illness Viral symptoms associated with decreased risk of SBI Diarrhea associated with increased risk of SBI 1% 21% 19% Kids <18 yo with temp >106 (41.1) Serious bacterial infection Lab confirmed viral illness

80. 81 Stanley R et al. Pediatric Emergency Care 2005 Over 5000 infants younger than 3 months with fever were retrospectively reviewed 98 patients (1.7%) had temp >40 C (104F) Prevalence of SBI among febrile infants >40 C was 38% compared with those with fever <40 C 8.8%

81. 82 Mastitis

82. 83 WWTDD? week

83. 84 Kharazmi SA et al. Pediatr Emer Care 2012 Retrospective cohort study of patients 0-28 days seen in 2 large PEDs for SSTIs 136 neonates identified, 104 met inclusion criteria Blood cultures obtained in 13% pustulosis, 96% of cellulitis, 69% of abscesses Admission rates for pustulosis, cellulitis, abscesses were 13%, 84%, and 55%, respectively No SBI noted

84. 85 Retrospective case series Included patients from birth to 120 days 130 patients identified, 94 included in study No

infant with a positive breast culture had a positive blood, urine, or CSF culture Montague EC et al. The Pediatric Infectious Disease Journal 2013 Recommendations: No LP in well appearing afebrile infants with mastitis Consider LP in infants <60 days old with mastitis and fever

85. 86 Concomitant viral infections

86. 87 844 febrile infants ≤60 days of age who were tested for influenza, A significantly lower rate of serious bacterial illness (SBI) was noted in the 123 infants who were influenza-positive compared with the 721 infants who were influenza-negative: 2.5 percent versus 11.7 percent If the CBC and urinalysis do not suggest bacterial infection, lumbar puncture can be omitted in well- appearing febrile infants who are older than 28 days of age, have a positive rapid influenza test, and no evidence of bacterial infection on physical examination. Mintegi S et al. Pediatric Infectious Disease Journal 2009

87. 88 Smitherman HF et al. Pediatrics 2005 705 febrile kids 0-36 months Lower incidence of bacteremia, UTI, pneumonia, or any SBI in kids found to have influenza A 10% SBI rate in Flu A + vs. 28% SBI rate in Flu A -

88. 89 SBI in 30/312 (9.6%) infants without bronchiolitis and 3/136 (2.2%) with bronchiolitis Bilavsky E et al. Pediatr Infect Dis 2008) Prospectively looked at 448 febrile infants <3 months with and without bronchiolitis

89. 90 Byington CL et al. Pediatrics 2004

90. 91 Titus MO et al. Pediatrics 2003 Retrospective cohort study of febrile infants <8 weeks 174 kids with fever and a positive RSV test were matched with 174 kids with fever and a negative RSV test 2 patients in RSV group had SBI (both UTI) vs. 22 in control group

91. 92 Levine DA et al. Pediatrics 2004 1248 febrile patients <60 days enrolled into prospective cross-sectional study 7% SBI rate for RSV+ infants vs. 12.5% SBI rate for RSV- infants

92. 93 Levine DA et al. Pediatrics 2004 5.5% of RSV+ infants had UTI Febrile infants with RSV are less likely to have SBIs but its probably wise to get a urine culture on these kids

93. Can we avoid LP in the 1-2 month old? 94 5

94. 95 <28 days 1-2 months >2 months >28 days

95. Algorithm for Managing Fever of Unknown Source in Neonates (0-28 days) Evidence-Based Care Guideline for Fever of Unknown Source. Cincinnati Children's Hospital Medical Center 2010 Start Diagnostic tests CBC with di , blood culture UA, urine culture CSF Stool culture (if diarrhea) CXR (if tachypneic, hypoxemic, etc.) Focal Infection? Admit Antibiotics (Amp, Gent/Cefotax) CSF pleocytosis AND negative CSF gram stain? Consider CSF HSV PCR and antiviral therapy O the algorithm Evaluate and treat as appropriate to site and severity Yes No Yes

96. Algorithm for Managing Fever of Unknown Source in Young Infants (29-60 days) Evidence-Based Care Guideline for Fever of Unknown Source. Cincinnati Children's Hospital Medical Center 2010 Start Diagnostic tests CBC with di , blood culture UA, urine culture Stool culture (if diarrhea) CXR (if tachypneic, hypoxemic, etc.) RVP Focal Infection? O the algorithm Evaluate and treat as appropriate to site and severity CSF Start antibiotics Admit Low-risk criteria met? Yes No No Yes

97. No social or family concerns? Available reliable follow-up in 12-24 hours? Adequate parental education? Outpatient plan OK with PCP and family? Admit for observation until cultures negative If condition worsens: CSF, antibiotics Consider outpatient management with or without antimicrobial therapy Get CSF if antibiotics will be started Plan to follow-up in 12-24 hours Algorithm for Managing Fever of Unknown Source in Young Infants (29-60 days) Evidence-Based Care Guideline for Fever of Unknown Source. Cincinnati Children's Hospital Medical Center 2010 Yes No

98. 99 Variation in Care There's still debate regarding who gets a full septic work up Respect the worst case scenario How comfortable are you sending this kid home without a full workup?

99. 100 Low Risk Criteria

100. 101 The Workup Kids < 28 days get a full septic work up and admission Kids > 28 days get blood and urine +/- CXR, stool, RVP Kids >60 days with a high fever consider urine Sick looking kids get full septic work up Kids >60 days don't get routine blood cultures anymore b/c occult bacteremia rate is so damn low

101. 102 Di cult Clinical Scenarios Dry tap? Admit, re-tap later or follow cultures if looking well Traumatic tap? Remember 1:1000 WBC:RBC ratio Really high fever? Consider empiric antibiotics if no viral source Infant with mastitis? <1 month full w/u >1 month blood culture, abx, admit 4-6 week febrile infant with viral source? Urine is probably enough then home if low risk

102. 103 Can we avoid LP in the 1-2 month Yeah, probably. If low risk and viral symptoms you can make a pretty strong case to your attending that you can get away with no LP

103. 104

104. 105 NCAA Men's Basketball Coaches with the most Final Four Appearances John Wooden (12; UCLA): 1962, 1964, 1965, 1967, 1968, 1969, 1970, 1971, 1972, 1973, 1974, 1975 Mike Krzyzewski (11; Duke): 1986, 1988, 1989, 1990, 1991, 1992, 1994, 1999, 2001, 2004, 2010 Dean Smith (11; UNC): 1967, 1968, 1969, 1972, 1977, 1981, 1982, 1991, 1993, 1995, 1997 Rick Pitino (7; Providence (1), Kentucky (3), Louisville (3)): 1987, 1993, 1996, 1997, 2005, 2012, 2013 Roy Williams (7; Kansas (4), UNC (3)): 1991, 1993, 2002, 2003, 2005, 2008, 2009

105. 106 Variation in Care of Neonatal/Young Infant Fever Within Our Pediatric Emergency Department Full septic w/u if <8 weeks Full septic w/u if <6 weeks Full septic w/u if <4 weeks * 3 of these attendings will move this to <4 weeks if there is a viral source * n=9 67% 22% 11%

106. 107

107. 108

108. 109

109. 110

110. 111 THANKS

Recommended



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Fever without a source in Pediatrics
MedPeds Hospitalist



Fever
Chapter Review
Rashidi Ahmad



L3.approach to fever
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The Febrile Neonate and Young Infant: An Evidence Based Review
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Approach to history taking in a patient with fever
Reina Ramesh



An approach to a child with fever
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