including older and clinically extremely vulnerable people, such as those on haemodialysis[12] or undergoing treatment for cancer[13] remain crucial to understanding immunity in groups that are most at risk and require a larger share of health-care resources should they fall ill. Overall, it remains crucial to monitor NAbTs over time in diverse cohorts. Many aspects of cellular immunity are at play, yet both preliminary reports of mortality reduction in antibody-negative adults infected with the alpha VOC and treated with combined casirivimab and imdevimab),[14] and recent reports of concomitant NAb waning and increasing risk of hospitalisation or death[15] across multiple populations suggest ongoing assessment of NAb against SARS-CoV-2 variants will continue to be part of an effective strategy against COVID-19 as the pandemic continues to evolve.

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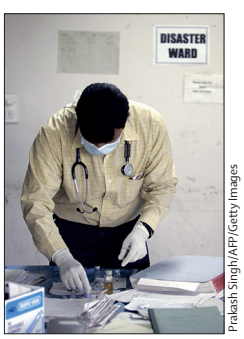
Steroid use in non-pneumococcal and non-*Haemophilus* bacterial meningitis



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We thank Diederik van de Beek and colleagues[1] for their Seminar on the management of bacterial meningitis, but would like to question their statement that "dexamethasone should be continued for 4 days in all patients, except in those with *L*[*isteria*] *monocytogenes*". Although the authors outlined the evidence for improved outcomes in patients with pneumococcal meningitis and poor outcomes in patients with neurolisteriosis, insufficient evidence was presented to support dexamethasone use in other forms of meningitis, such as meningococcal.

In a Cochrane review of adjunctive corticosteroid use in patients with meningitis, Brouwer and colleagues[2] found a significant reduction in mortality for pneumococcal meningitis in subgroup analysis (risk ratio 0·84, 95% CI 0·72–0·98), but not for meningococcal or *Haemophilus influenzae* meningitis. In *H influenzae* meningitis, corticosteroids significantly reduced the risk of severe hearing loss (0·34, 0·20–0·59) with no reduction found in cases of non-*Haemophilus* spp meningitis.

The evidence from this Cochrane review has informed UK guidelines, which state that "steroids should be then stopped, if a cause, other than *Streptococcus pneumoniae* is identified",[3]

For **data and R code on GitHub** see https://github.com/davidlvb/Crick-UCLH-Legacy-Omicron-2021-12

as well as European guidelines, which report that "dexamethasone should be stopped… if the bacterium causing the meningitis is a species other than *H. influenzae* or *S. pneumoniae*".[4]

Is there now a consensus among experts in this field that accumulation of evidence permits extrapolation of the recommendation for steroid treatment to all types of bacterial meningitis with a known causative organism, except for neurolisteriosis? There does not seem to be any new, conclusive, high-quality evidence on the basis of the Seminar.[1] Or should we continue following the UK and European guidelines, and stop use of dexamethasone in patients with non-pneumococcal meningitis?

We declare no competing interests.

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Authors' reply

We thank Dominic Heining and Aiden Plant for their comments on our Seminar,[1] whereby they raised the question on whether adjunctive dexamethasone therapy should be continued for 4 days in patients with community-acquired bacterial meningitis caused by pathogens other than *Streptococcus pneumoniae*.

The Cochrane review[2] showed that adjunctive corticosteroids were effective in reducing hearing loss and neurological sequelae in patients with bacterial meningitis caused by all pathogens. In subgroup analyses, corticosteroids reduced severe hearing loss in children with *Haemophilus influenzae* meningitis and mortality in adults with *S pneumoniae* meningitis.[2] For *Neisseria meningitidis*, the subgroup analysis showed no effect on any of the outcome measures; however, it should be noted that the event rate in meningococcal meningitis is substantially lower than that in pneumococcal meningitis.

In the Cochrane review, the benefits of dexamethasone therapy for adults was mainly driven by the results of one multicentre European trial.[3] This study showed that adjunctive dexamethasone reduced unfavourable outcomes in adults with community-acquired bacterial meningitis.[3] The absence of a significant clinical benefit in some subgroups does not rule out the beneficial effect of dexamethasone in these subgroups, because the study was not powered to analyse subgroups.[4] Additionally, the most striking effect of dexamethasone was seen in pneumococcal meningitis; however, similar (non-significant) point estimates for focal neurological abnormalities and hearing loss were also seen for meningococcal meningitis.[3]

In 2016, after the European Society of Clinical Microbiology and Infectious Diseases guidelines were drafted,[5] a nationwide cohort study, including 1412 episodes in 1391 adults with community-acquired bacterial meningitis, showed that the proportion of patients with unfavourable outcomes was lower in individuals treated with adjunctive dexamethasone according to guideline recommendations (10 mg four times daily for 4 days)[5] than in those who did not receive the therapy according to these recommendations (360 [34%] of 1075 *vs* 157 [51%] of 309; p<0·0001).[6] In a multivariable analysis that included all baseline variables, the adjusted odds ratio of dexamethasone treatment for unfavourable outcomes was 0·54 (95% CI 0·39–0·73) and that for death was 0·46 (0·32–0·66).[6] The adjusted odds ratio for the association between dexamethasone treatment and unfavourable outcomes was 0·55 (0·38–0·80) in patients with pneumococcal meningitis and 0·44 (0·23–0·85) for patients with meningitis caused by other pathogens.[6]

To conclude, dexamethasone should be initiated with the first dose of antibiotics in all patients with community-acquired bacterial meningitis beyond the neonatal age. On the basis of available evidence, we advise to continue dexamethasone treatment in this patient group for 4 days regardless of microbial cause, except in patients with *Listeria monocytogenes*.

We declare no competing interests.

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