

COMMENTARY

Melbourne epidemic thunderstorm asthma event 2016: Lessons learnt from the perfect storm

Key words: aeroallergens, pollen, thunderstorm asthma.

As we approach the second anniversary of the world's largest and most catastrophic episode of epidemic thunderstorm asthma (ETSA) in Melbourne on 21 November 2016, it is timely to review the factors contributing to, and the lessons learnt from, this perfect storm. Also, particularly relevant for review are the actions that have been taken and what else can and needs to be done.

Thunderstorm asthma occurs due to a complex interaction of environmental and individual susceptibility factors. Environmental factors include high concentrations of an aeroallergen and presence of thunderstorms, with particular thunderstorm characteristic of outflows bringing atmospheric aeroallergens to ground level. Individual risk factors include allergen sensitization and exposure, with the presence of rhinitis being both a marker of allergic sensitization as well as a risk factor for latent and undiagnosed asthma. In those with diagnosed current asthma, low adherence to preventive inhaled steroids increases thunderstorm asthma risk. Internationally, the aeroallergens responsible for ETSA events have been reported to be derived from moulds, as well as weed, tree and grass pollens. However, Australian episodes have been exclusively due to perennial ryegrass which is the most commonly sown pasture grass in Australia. There is also a particular characteristic of ryegrass pollen grains which make them a potent trigger of thunderstorm asthma: ultrafine allergen-coated starch particles ($<2.5\ \mu\text{m}$ in diameter) within the pollen grains are released by osmotic shock on contact with water, which are then respirable to the small airways.¹

Melbourne has been particularly susceptible to ETSA events, with the first reported occurrence in November 1984, following closely after the initial described episode in Birmingham, UK, in July 1983. Since then, Melbourne has suffered 7 of the 10 Australian, and 22 episodes worldwide reported to date.² The geographical, environmental and population factors making Melbourne particularly susceptible are likely to include the large rural grassland pastures to the north; the typical weather pattern of hot north winds pushing aeroallergens south, prior to cool-change bearing thunderstorms osmotically releasing ultrafine allergen-bearing starch particles, and exposing them to a large susceptible urban population. All seven Melbourne ETSA episodes have occurred in late spring during the peak ryegrass pollen and thunderstorm-prone month of November. However, the 2016 Melbourne ETSA event was outstanding in size and severity by orders of magnitude compared to previous events, raising

questions of what were the environmental, health service and patient susceptibility factors contributing to this.³

The spring of 2016 was Victoria's 10th wettest, with record of high rainfall in September, predisposing to high pastureland growth in October and November. This was followed by a drier than average November with grass pollen counts reaching extreme (>100 grains/ m^3 of air) on 3 days in the first half of the month. 21 November was the last day of a 10-day heat-wave, with gusty northerly winds ahead of a cool-change bringing a north-south line of thunderstorms crossing the centre of Melbourne at 1800 h. A significant proportion of the population was outdoors, either commuting home from work, or at the beach seeking relief from the heat. From 1800 h, the huge epidemic surge of people seeking medical help for acute respiratory symptoms overwhelmed emergency services. There was unprecedented demand for urgent ambulance attendance, with significantly increased out-of-hospital cardiac arrest and pre-hospital deaths. The official figure of 3365 excess respiratory-related cases presenting to Melbourne and Geelong public hospital emergency departments (ED) in the ensuing 30 h does not include those who attended private hospital ED, community pharmacies and general practices seeking relief, as well as many with symptoms who did not seek medical attention.⁴ Hence, estimates of up to 10 000 people being affected are not excessive. There was a 10-fold increase in public hospital asthma admissions including 35 to intensive care units (ICU), 5 of whom died due to neurological complications associated with cardiac arrest. There were 10 deaths overall, although the highly commendable efforts of emergency and intensive care services prevented what would otherwise have been an even greater tragedy. The outcome of a coronial inquest into the factors contributing to these deaths is still pending.

In the aftermath of this crisis, follow-up of those who had attended public hospital ED found them to be mainly young adults with an average age of 32 ± 19 years, 56% male, 87% with a history of rhinitis, but 56% had never been previously diagnosed with asthma. Of those who had an asthma diagnosis, just under two-thirds had 'current asthma' with symptoms within the previous 12 months (28% overall). Of those with current asthma, 68% were either not prescribed inhaled steroids or using it less than 5 days per week. A significantly higher proportion of ETSA sufferers were of East and South-East Asian as well as Indian subcontinental ethnic origin (39%) compared to background census-derived data (25%).

Taken together, a perfect storm of environmental and patient factors contributed to the unprecedented severity of the Melbourne 2016 ETSA event. From an environmental perspective, climate change may have contributed to the extreme weather patterns including heavy rain and prolonged dry spells as well as increased frequency of thunderstorms. It may also have a role with increasing atmospheric carbon dioxide concentrations and temperatures impacting aeroallergen levels. The patient factors included: poor prescription and adherence to inhaled steroids in those with current asthma; latent or undiagnosed asthma in those with allergic rhinitis; and outdoor exposure at the time of highest ETSA risk. With Melbourne's multi-ethnic population, the Asian/Indian migrant's increased susceptibility to allergy previously documented in pivotal Australian studies likely added another important factor to this unique mix. The unprecedented sheer number of cases overwhelmed a health system which performed commendably in an environment of considerable uncertainty characterized by rapidly escalating demands.

Important lessons have been learnt, and a system of ETSA forecasts has been implemented to improve situational awareness and health system responsiveness during the Victorian grass pollen season from 1 October to 31 December each year.⁵ Public and health professional education campaigns are being conducted through the National Asthma Council and other professional bodies.⁶ More needs to be done to help improve prescription of and adherence to inhaled steroids in known asthma sufferers, as well as recognition of at-risk groups with rhinitis and latent or undiagnosed asthma. Funding is required for research with case-control studies to further address individual sus-

ceptibility factors. While this will require appropriate investment, what cannot be afforded is complacency that the Melbourne 2016 ETSA episode was a freak once-off event.

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REFERENCES

- 1 Suphioglu C, Singh MB, Taylor P, Bellomo R, Holmes P, Puy R, Knox RB. Mechanism of grass-pollen-induced asthma. *Lancet* 1992; **339**: 569–72.
- 2 Inspector-General for Emergency Management. Review of response to the thunderstorm asthma event of 21–22 November 2016 Final Report. Department of Justice and Regulation, Victoria State Government, Melbourne; 2017. https://www.igem.vic.gov.au/sites/default/files/embridge_cache/emshare/original/public/2017/07/80/c414fe2ba/ReviewofemergencyresponsetoNovember2016thunderstormasthmaeventfinalreport.pdf
- 3 Thien F, Beggs PJ, Csutoros D, Darvall J, Hew M, Davies JM, Bardin PG, Bannister T, Barnes S, Bellomo R. The Melbourne epidemic thunderstorm asthma event 2016: an investigation of environmental triggers, effect on health services, and patient risk factors. *Lancet Planet Health* 2018; **2**: e255–63.
- 4 Clayton-Chubb D, Con D, Rangamuwa K, Taylor D, Thien F, Wadhwa V. Thunderstorm asthma – revealing a hidden at-risk population. *Intern. Med. J.* 2018. <https://doi.org/10.1111/imj.13800>.
- 5 <https://www2.health.vic.gov.au/public-health/environmental-health/climate-weather-and-public-health/thunderstorm-asthma/forecasting>. Accessed 2 September 2018.
- 6 <https://www.nationalasthma.org.au/news/2018/health-professional-workshops-thunderstorm-asthma>. Accessed 2 September 2018.