ger RNA from that carrying the *mdx4cv* mutation. As shown in Fig. 1b, c, a 5′ primer specific to the wild-type sequence allowed amplification of a 240-base-pair fragment encompassing exons 53 and 54 of mRNA extracted from muscle tissue of control C57Bl/6 and all transplanted animals, but not from mRNA from mock-transplanted *mdx4cv* mice. All PCR reactions were internally normalized by simultaneous amplification of a 378-base-pair fragment encompassing exons 33–36.

Our results indicate that repair by bone-marrow-derived cells never exceeds 1% of total muscle fibres during the lifespan of transplanted *mdx* mice. Transplantation of total bone marrow, or even of highly enriched stem-cell fractions from bone marrow[2], therefore has a very limited impact on muscle-cell replacement, and no ameliorating effect on murine muscular dystrophy. This might be explained by poor recruitment of bone-marrow cells to the dystrophic muscle, or by bone-marrow-derived cells having no selective advantage over resident myogenic precursors, which regenerate muscle throughout life in *mdx* mice.

We do not address strategies for overcoming these limitations here, although they are likely to be the focus of future research. It should be stressed that the *mdx* mouse model does not reproduce the clinical picture of Duchenne's muscular dystrophy in humans, in which muscle degeneration gives rise to fibrosis rather than to repair[5], so it remains possible that dystrophin-producing cells derived from bone marrow might be subject to positive selection in a human context.

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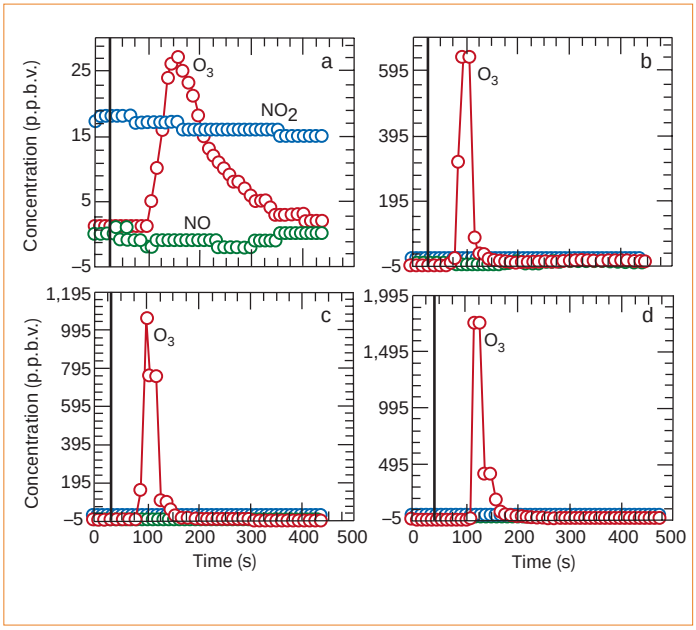

Figure 1 Ambient concentration (parts per billion by volume) of O_3 (red circles), NO (green) and NO_2 (blue) in the environment as a function of time after lighting colour-emitting 'pencil' sparklers. **a–d,** Values correspond to the simultaneous burning of one, three, four and six sparklers, respectively; vertical black lines indicate the duration of burning for the sparklers (starting at 0 s). O_3 begins to accumulate in each case at around 100 s; this time lag corresponds to the volume of air in the assembly of the Teflon tube and manifold attached to the O_3 and NO_x analysers. During the experiments, the open end of the Teflon tube leading to the analysers was kept 900 cm away from the sparklers. The average weight of inflammable material (initial weight minus weight after burning) was 9.15 ± 0.85 g per sparkler. The burn time varied from 26 s for one sparkler to a maximum of 42 s for six; this variation was due to differences in the weight of the burning mixture. O_3 formation was independent of microclimatic factors such as temperature and humidity of the ambient air. The concentrations of NO and NO_2 did not change during the O_3 burst. Further details are available from the authors.

Microclimate

Formation of ozone by fireworks

Ozone is a secondary pollutant and greenhouse gas that is formed from molecular oxygen in the presence of sunlight and nitrogen oxides. The extent of production also depends on the presence of volatile hydrocarbons, carbon monoxide and methane[1–6]. But we have discovered a surprising source of ozone which is generated in spontaneous bursts even in the absence of sunlight and nitrogen oxides — namely, the exuberant mass of colour-emitting sparklers that are lit during the Diwali festivities, which take place every year during October and November in Delhi, India. The underlying process of ozone formation resembles that induced by ultraviolet radiation in the stratosphere[7,8].

We undertook a routine, real-time monitoring of the concentrations of NO_x (NO and NO_2), O_3 and other microclimatic factors at a known pollutant-receptor site[9] in Delhi in order to determine the effects of burning unprecedented numbers of fireworks on the local environment during the festive period in November 1999. We found that during the festival period the ozone concentration peaked at around noon and fell to negligible levels after sunset.

On Diwali night (7 November), a small build-up of O_3 (9 ± 1 parts per billion by volume) was detected between 20:40 and 02:30 hours (results not shown). During this period, no correlation was found between NO_x concentration and O_3 formation, indicating that the ozone was unlikely to have been generated in reactions involving ambient NO_x. This observation was surprisingly different from night-time O_3 measurements obtained on the other dates, when no O_3 formation was detected.

Further experiments carried out under different climatic conditions showed that there is a linear regression between the total amount of inflammable material present in sparklers and the cumulative O_3 formed (correlation, 0.993). There was no change in ambient NO_x concentration before, during or after these experiments (Fig. 1).

Sparklers depend on a combination of different metal salts to generate their colour and sparkle[10] — these include potassium perchlorate, sulphur, strontium nitrate, barium nitrate, sodium oxalate, calomel, aluminium and manganese. When burnt, a significant proportion of the light emitted by these constituents has a wavelength below 240 nm (ref. 11). The radiative energy of these emissions is sufficient to dissociate atmospheric molecular oxygen into atomic oxygen, enabling the reaction $O_2 + O \rightarrow O_3$ to take place. This proposed mechanism could explain the formation of bursts of O_3 without the participation of NO_x, and is therefore similar to the process of ultraviolet-radiation-induced formation of O_3 in the stratosphere[7,8].

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