maximum height of 152-183 m; it weighs 200 g and contains 65 stars of about 80 g total weight. The average thrust is 4.31 kg. For a missile to perforate the skin and its underlying tissues a minimum velocity of around 70 m/s is necessary with an energy per unit area of presentation of about 2.1 m.kg/cm².^{1,2} In this case the rocket's projectile explosive force lodged it into the clothes or just under the skin (the upper end of the rocket being conical) and was superseded by the explosive force that released the stars; thus two complementing forces caused this injury. The extent of the injury has many factors, important ones being the mass, velocity, density, shape, and area of presentation of the missile and the distance traversed. Whatever the circumstance this size of rocket can cause severe bodily harm, which might even prove fatal.

We have been unable to find any report of a penetrating abdominal wound by a firework, although a penetrating sternal wound associated with a pneumomediastinum in a 10 year old boy who was struck by a plastic rocket³ and a penetrating bone wound resulting from a firework⁴ have been described. Fireworks will probably not be banned in the near future. The incidence of injuries can be further reduced by better organisation during displays.⁵ Displays should be supervised only by responsible adults who are fully aware of the potential dangers. Any firework that fails to fire should not be touched but should be doused with water.

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Leucocytosis induced by exercise

Exercise induces an immediate leucocytosis, its magnitude being proportional to the intensity of work and duration of exercise,¹ although a given workload causes a greater leucocytosis in unconditioned subjects than trained athletes.² We report the effects of 30 minutes' vigorous exercise in healthy male volunteers.

Subjects, methods, and results

We studied 10 healthy white men (mean age 42.5, range 26-52) who continued their usual daily routine for 24 hours before the study but avoided strenuous exercise. For the study each man exercised at a rate close to his maximum for 30 minutes between 1000 and 1100, swimming about 1 km, playing squash, or jogging roughly 6 km (13 sessions altogether (five jogging, four squash, and four swimming): nine men did one each and one did four). Blood samples were taken immediately before and after exercise and at intervals over the next five and a half hours. Control samples were taken at similar times during a normal working (control) day. Leucocyte counts were measured by routine procedures.

Counts in control samples were within the normal range except for one that was slightly low. During the control day leucocyte numbers increased slightly (table). Immediately after 30 minutes' exercise the mean leucocyte count had risen to 115%, but by one hour it had fallen to 104% compared with mean control counts (=100%). These mean values, however, hid considerable individual variation. In eight subjects exercise caused a small immediate increase in leucocyte numbers; at one hour the count had fallen to baseline in four men but remained the same or had even increased in the others. The two other subjects had an immediate slight decrease in leucocyte numbers, which persisted until one hour. Irrespective of the immediate effect a delayed and prolonged leucocytosis that reached a peak between two and four hours was noted in all subjects; this was predominantly due to a rise in neutrophils. The leucocyte count did not exceed the upper limit of normal immediately after exercise in any of the subjects, but it did so during the delayed leucocytosis in six of the 13 sessions (done by four of the 10 subjects). The magnitude of the delayed leucocytosis (mean 175%, n=13) varied greatly among subjects (range 112-235%) when compared with control values before exercise (=100%). It was unrelated to the type of exercise but was most pronounced in subjects who took a little or no regular exercise.

Comment

Our results show that a short period of vigorous recreational exercise can induce a substantial delayed leucocytosis; this seems to have been overlooked previously because samples were not taken at appropriate times. Interestingly, a polymorph leucocytosis of extremely variable degree that occurred some hours after 10 minutes' exercise was noted in one study of lymphocyte subpopulations but not investigated further.³ A biphasic leucocyte response, similar to that reported here, was noted after administration of adrenaline.⁴ We suggest that adrenaline released during exercise causes a small immediate leucocytosis in most people by its direct effect on leucocyte demargination. The second, delayed leucocytosis may occur because cortisol acts subsequently to release leucocytes from the bone marrow.⁵

Sports aimed at maintaining cardiovascular fitness are becoming increasingly popular; it is therefore important to know both the long and short term effects of exercise on variables measured routinely in clinical practice. Further studies are needed to determine how age, sex, workload and duration of exercise, and physical fitness might affect the magnitude of the delayed leucocytosis induced by exercise and to elucidate the mechanisms. Caution is clearly needed when interpreting the importance of a raised leucocyte count in samples taken within a few hours of even short periods of moderately vigorous exercise.

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Effect of half an hour of exercise on leucocyte count ($\times 10^9/l$). Results are the means of 13 experiments (SD)

	Baseline	Time (h) after start of exercise				
		1/2	1	2 3/4	4 1/2	6
Exercise	5.97 (2.02)*‡	7.45 (1.45)‡	6.97 (1.74)	10.45 (3.27)*†	10.00 (3.05)	8.83 (2.67)
Control period§	6.68 (1.52)	6.49 (1.50)	6.73 (1.50)	6.83 (1.47)†	7.02 (1.36)	7.19 (1.55)

By paired *t* tests the difference between these two counts was significant: **p*<0.01; †*p*<0.01; ‡*p*<0.05.

§Random activity.