and wrong environmental factors (e.g. too much training on roads) can produce athletic injury.

Heredity will alter structure by, for instance, varying the proportion of slow and fast fibres in muscles. This cannot be altered and will determine the type of sport a person can do and thus, indirectly, the likely injuries. A weight lifter has the structure to lift 200 kg at once, but his very structure means he will be open to particular injuries, especially spinal injuries.

Different training schedules will also be associated with different types of injury. Training for long distance running can mean 150 miles of road work per week, leaving the athlete open to impact injuries, and injuries to the knees and Achilles tendons. By contrast, a shot-putter may be lifting 30 tonnes of weight six times per week, producing spinal injuries of a very specific type.

Injuries in sportsmen who do not train repetitively (the vast majority) will be completely different.

Marked physiological changes can be seen in today’s top-class athletes. For instance, cardiac output increases, as a result of increased stroke volume. This output may be as high as 30 to 50 l/min, and may be limited only by turbulent flow in the aortic arch. The athletic heart has other particular characteristics — bradycardia, irregular pulse, variable ECG, cardiomegaly — that are easily mistaken for disease. The ECG, with its wandering pacemaker, left ventricular hypertrophy, and inverted T-wave may lead to confusion between what is normal and abnormal. As in most areas of medicine, “normal” in sport is a spread, with some athletes being supernormal or above average. Lack of recognition of this may lead to lack of understanding of injuries.

Other physiological problems may occur, e.g. difficulty in maintaining a body temperature of \(37^\circ\), and replacement of water and electrolytes lost by sweating.

Mental approach is also important. There will always be athletes who have injuries, even permanent injuries, who win in spite of, or lose because of, their injuries; these people will have an excuse for failure. The reverse of this problem is the athlete who will not admit injury, and this emphasises the importance of attitude.

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**DISCUSSION**

Mr. Williams: Dr. Adams, if someone comes into Casualty with chest pain, how do you tell if it is of muscular origin?

Dr. Adams: It is almost impossible. In the young patient, the odds are against him having an infarction. The difficulty really occurs with a middle-aged jogger or 20- to 25-year-old endurance athlete who has collapsed. A casualty officer must assume that any ECG changes are caused by disease.