

Sweat and blood – runner's haematuria: discharge or further evaluate?

汗液與血液—賽跑員的血尿：出院或進一步的評估？

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An elite runner presented with macroscopic haematuria after six hours of non-stop running during his training for Trailwalker. The haematuria resolved after two days of conservative treatment. The history, pathophysiology and complication of runner-related haematuria are discussed. A simplified management plan is suggested in order to avoid unnecessary anxiety to the patients, inappropriate referral and wasting of medical resources. (*Hong Kong j.emerg.med.* 2005;12:32-35)

一名優秀的賽跑運動員在毅行者訓練中連續六小時不停跑步後出現肉眼可見的血尿，病者經過兩天保守療法後，血尿情況得以消退。本章討論有關賽跑員血尿的病歷、病理生理學及併發症，並建議一個簡單的處理方法以避免病者不必要的焦慮、不適當的轉介和浪費醫療資源。

Keywords: Glomerular filtration rate, renal papillary necrosis, Trailwalker

關鍵詞：腎小球濾過率、腎乳頭壞死、毅行者

Case summary

A 46-year-old Chinese man presented to our accident & emergency department in August 2004 for gross haematuria after six hours of running during his training for Trailwalker. He finished the trail in about 17 hours in the previous year. He increased his training intensity and aimed at finishing the trail in about 15 hours. On presentation, his condition was good with excellent physique. His blood pressure and pulse were normal. He had no fever. Clinical examination was normal. Urinalysis showed macroscopic haematuria and proteinuria. He was admitted to our observation ward for treatment. Oral rehydration solution was given and increased water intake was encouraged.

Four hours later his haematuria changed from macroscopic to microscopic. Complete blood picture, renal and liver function tests were all unremarkable. The creatine kinase level was 337 iu/L (normal range 24-180 iu/L). Myoglobin, troponin I and creatine kinase-MB fraction were not taken. Since his condition was stable, he was discharged home on the next day. At the follow-up two days later, there was no more proteinuria or haematuria, both macroscopically and microscopically. Up to the end of November 2004, he had no recurrent symptoms. Actually, he finished Trailwalker in the above month with an excellent result: within 15 hours and won a high place! He had followed our advice by drinking plenty of water before and during the competition.

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Discussion

History

Trailwalker, a 100 kilometers race, is a yearly event in Hong Kong. There are lots of amateur and recreational

runners joining the competition, testing their co-operation, dedication and endurance. Elite athletes usually run for hours in order to shorten the finishing time. During the event, it is not uncommon to encounter sports-related medical, surgical and orthopedics problems.

Barach first described microscopic haematuria in the urine samples of marathon runners (18 out of 19 runners, 94.7%) in 1910.¹ There was no complication seen. In 1956 Gardner described this feature as "athletic pseudo-nephritis" which he believed to be benign and reversible.² To our knowledge, there was only one published case report of running-related macroscopic haematuria while the rest were only microscopic haematuria. This was a 42-year-old Caucasian female who presented with macroscopic haematuria after training. Investigations showed the bleeding was post-renal in origin and was exercise-induced.³

Patho-physiological mechanisms (Figure 1)

Firstly, once the athlete starts to run, his body

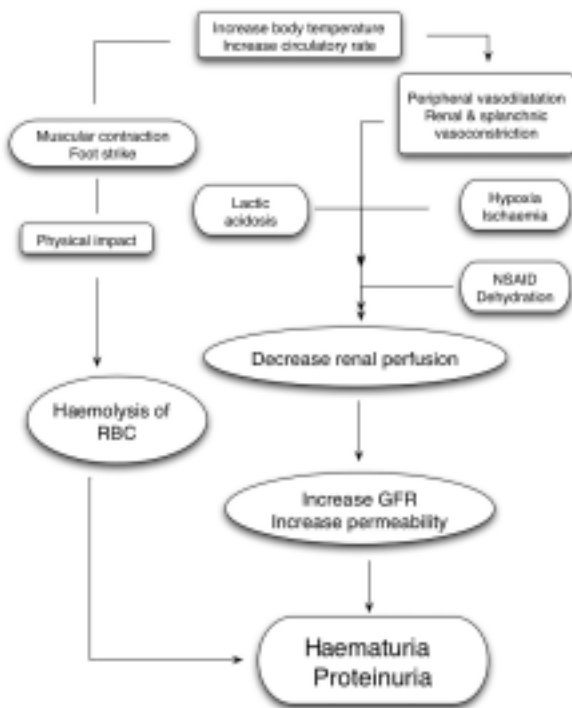


Figure 1. Pathophysiological mechanism of haematuria and proteinuria (GFR=glomerular filtration rate, RBC=red blood cell).

temperature rises. His circulatory rate and flow increase as well.⁴ Peripheral vasodilatation occurs for sweating. Renal and splanchnic vasoconstriction follows, causing hypoxia to the kidneys.⁵ Renal perfusion decreases but the glomerular filtration rate (GFR) increases as a result of compensation.⁵

Secondly, muscular contraction during intense running squeezes the red blood cells causing haemolysis. The more intense the contraction is, the more severe the haemolysis.⁶

Thirdly, running may lead to impacts of the posterior bladder wall against its base, and of the kidneys due to the physical movement. The degree of haematuria is directly proportional to the total distance covered and the intensity of the exercises,⁵⁻⁷ and 21-25% of patients with microscopic haematuria had a running distance of 21-90 kilometers.^{3,7-9}

Fourthly, pre-competition dehydration, hyperthermia, lactic acidosis, ischaemia and use of non-steroidal anti-inflammatory drugs (NSAID) can all predispose to a reduction in renal perfusion.^{9,10}

Together with haemolysis of red blood cells and increase of GFR, protein and red blood cells would then be squeezed out, resulting in proteinuria and haematuria.⁷

Affected biochemical markers

Although scientists wonder how intense running can affect our human body, there are not too many studies on this. Gerth et al recruited 51 healthy subjects to finish 100 kilometers within 14.25 hours.⁵ All had to reach the finishing line together. The environmental temperature was between 7-12°C. The average amount of water consumed was 4 liters per person throughout the study. Blood tests after the race showed that serum sodium, potassium, albumin and protein decreased significantly but still remained within physiological limits. Myoglobin, creatine kinase and troponin I increased but not to myocardial damage levels. The release of enzyme was attributed to hyperthermia, muscular contraction, ischaemia and acidosis. Glycosuria and haematuria occurred for six hours after

the race in 9.1% and 6.8% of the patients respectively. There was no dysmorphic feature of the red cells in the urine that signified that bleeding was originated from the glomerular region. No macroscopic haematuria was noted.⁵

Jones et al performed a similar study in which ten subjects (seven males and three females) were tested. All were competitive middle distance runners with at least two years of competitive running experience. They were asked to run at different intensities according to the study protocol, and 90% of the athletes showed post workout haematuria at least once. All resolved within two hours of recovery.⁷

Complications

Since laboratory studies showed benign and reversible result, do we have to bother? Ducloux et al reported renal papillary necrosis in a 35-year-old male marathon runner who presented with loin pain and haematuria after the run. The exact aetiology of the necrosis was uncertain but it might be related to ischaemic and hypoxic damage to the kidney as a result of intensive running.¹¹ Death has been reported because of electrolyte disturbance due to prolonged running.¹²

Management plan

History is most important to differentiate whether the patient is suffering from reversible haematuria or underlying pathologies. Most runner-related haematuria is painless except the case reported by Ducloux et al. Any painful or persistent painless haematuria should raise the possibility of other differential diagnoses. Special attention should be directed to the conditions listed below: -

- Pre-existing renal diseases.
- Symptoms including flank pain and dysuria.
- Use of NSAID before the race.
- Persistent haematuria 72 hours after exercise.
- Dysmorphic feature with cellular cast.

Physical examination is useful to detect other pathologies that may co-exist such as benign prostatic hypertrophy or dissection of renal artery. Basic blood tests should be performed to detect electrolyte

abnormality, disturbance in muscle enzymes and impairment in renal function. A provisional management guideline is summarised in a flowchart (Figure 2). It should be modified according to the clinical suspicion and laboratory results.

Lessons to learn

Trailwalker is popular in Hong Kong. However, little information has been given to the public about the possible detrimental effect of prolonged running and intense exercises. In Hong Kong the temperature and humidity are much worse than those described in the previously published studies on this subject. Severe hypovolaemia, hyperthermia and acidosis are expected in many of those who take part in Trailwalker. Marathon and Trail-Walker are regular yearly events for athletes with different levels of fitness. A large-scale questionnaire survey with reagent strip urine test should be conducted in the future to study this problem in Asian athletes. We hope that this article arouses the attention of recreational runners, updates our knowledge to handle this problem, avoids inappropriate referral to urologists and prevents waste of medical resources and patients' time.

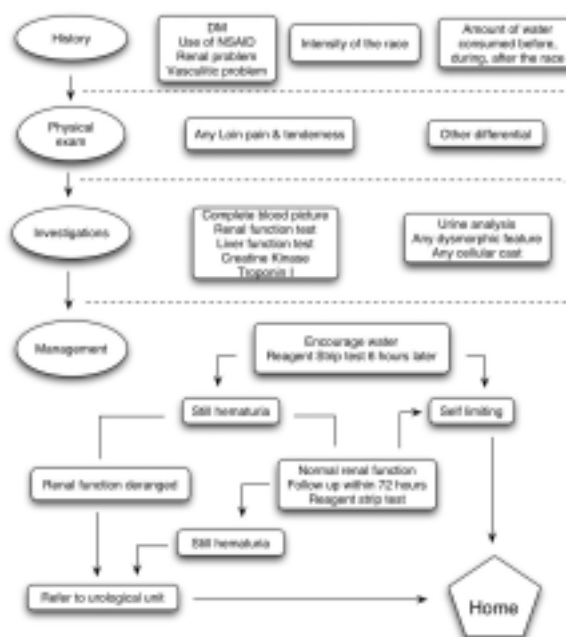


Figure 2. Management guideline for runner's haematuria (DM=diabetes mellitus).

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