


Case Report

Macroscopic hematuria caused by running-induced traumatic bladder mucosal contusions

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Abbreviations & Acronyms

CT = computed tomography
IRB = Institutional Review Board
MRI = magnetic resonance imaging

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Introduction: To clarify the mechanisms responsible for running-induced asymptomatic gross hematuria.

Case presentation: We identified 12 patients who visited our outpatient clinic with hematuria after running as a chief complaint. In 9 of 12 patients (75%), cystoscopic findings revealed mucosal contusions at the center of the posterior wall. Our examination including cystoscopy and magnetic resonance imaging revealed that this bladder contusion development was caused by the repeated contact of the bladder posterior wall against the fixed bladder neck by vertical motion in the empty bladder lumen during running. All patients with bladder contusion were male because the bladder neck is more firmly fixed to the pelvic floor by the protruding prostate in men than women. Gross hematuria in all patients quickly resolved without treatment after running cessation.

Conclusion: This is the first report in which cystoscopic findings showed that running-induced macroscopic hematuria can be frequently caused by traumatic bladder contusion.

Key words: bladder, contusion, hematuria, running, trauma.

Keynote message

The mechanisms responsible for running-induced hematuria are barely known. This is the first report in which our cystoscopic examination proved that running-induced macroscopic hematuria could be caused by the bladder contusions with a high probability of 75%. This study also made us estimate the mechanism that this bladder contusion occurred as a result of the repeated contact of the bladder posterior wall against the fixed bladder neck by vertical motion in empty bladder lumen during running.

Introduction

With the recent increase in exercise enthusiasts, we, urologists, have increasingly encountered patients who consulted our outpatient clinic for asymptomatic gross hematuria after noncontact exercise including running. However, the mechanisms responsible for running-induced hematuria are barely known. The aim of this study was to clarify this mechanism.

In this study, we identified 12 patients who visited our outpatient clinic with asymptomatic macroscopic hematuria after running as a chief complaint between January 2014 and December 2017. They had undergone urinalysis; urine culture, renal function, and urine cytology tests; flexible cystoscopic examination; and abdominal CT scan. We retrospectively analyzed the findings. The IRB of our hospital (Toranomon Hospital) approved this study (approved IRB No. 1712).

None of the patients took anticoagulants. Three patients (25%) had significant urological diseases that could cause macroscopic hematuria. One patient had non-muscle invasive bladder tumor, another had lower ureteral tumor, and one had impacted lower ureteral stone. In the other 9 of 12 patients (75%), cystoscopic findings revealed erythematous and/or

hyperemic mucosal contusions with/without bleeding at the center of the posterior wall, which was the same site in all patients (Fig. 1a–i). In one patient (Fig. 1h), cystoscopic and MRI findings in the nearly empty bladder lumen showed direct apposition of the flaccid posterior bladder wall against the bladder neck (Fig. 2). All patients with bladder contusion were male, had a median age of 48 (range 40–66) years, and ran long distances of over 10 km. There were no findings indicative of malignancy in urine cytology. Erythrocytes in the urine samples were normal without dysmorphic features, and there were no significant cellular casts, proteinuria, pyuria, or bacteriuria, which indicated that they did not have renal origin disease (e.g. glomerulonephritis) or urinary tract infection. Furthermore, they did not meet the serum creatinine-based definition of acute kidney injury. Gross hematuria in all patients resolved within a few days without treatment after running cessation. Four patients underwent follow-up cystoscopic examination, and bladder contusions resolved within a few months without running. In contrast, five patients had gross hematuria relapse after restarting running.

The prevalence of running-induced hematuria was about 20–25%.¹ According to literature, there are several estimated

reasons for running-induced hematuria: footstrike hemolysis, increased glomerular permeability, renal ischemia, nutcracker syndrome, and their combination.² Especially, the pathogenesis of running-induced macroscopic hematuria was previously thought to be of glomerular origin.² In this study, however, there were no data regarding renal origin. Macroscopic hematuria has been reported to be rarer than microscopic hematuria, with only 2% prevalence in marathon runners.³ Additionally, patients with gross hematuria were asymptomatic and immediately became normal. They usually may not consult urologists, and urologists do not perform any examination and treatment for this benign hematuria. To our knowledge, the pathogenesis is not well confirmed. Few reports have described cystoscopic findings related to running-induced hematuria.

Our cystoscopic examination proved that running-induced macroscopic hematuria could be caused by bladder contusions, with a high probability of 75% (Fig. 1a–i). Actually, there were some case reports on bladder contusion after running.^{4,5} Our examination revealed that this bladder contusion development was caused by the repeated contact of the bladder posterior wall against the fixed bladder neck



Fig. 1 Cystoscopic findings in nine patients (a–i) with running-induced hematuria revealed erythematous or hyperemic lesions with shaggy mucosa in the middle of the posterior wall, immediately after an episode of gross hematuria following long-distance running.

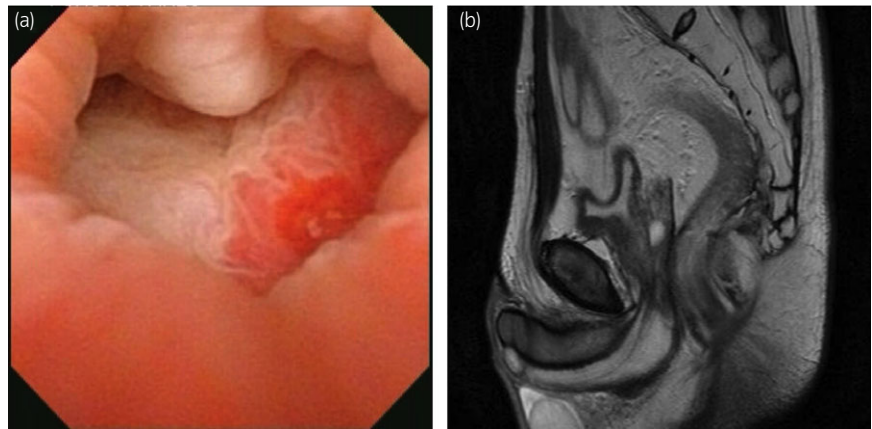


Fig. 2 (a) Cystoscopic finding (patient h in Fig. 1) in the bladder lumen through the bladder neck from the prostatic urethra showed erythematous and hyperemic mucosa at the center of bladder posterior wall against the bladder neck. (b) MRI finding (patient h in Fig. 1) in the nearly empty bladder lumen revealed direct apposition of the flaccid posterior bladder wall against the bladder neck.

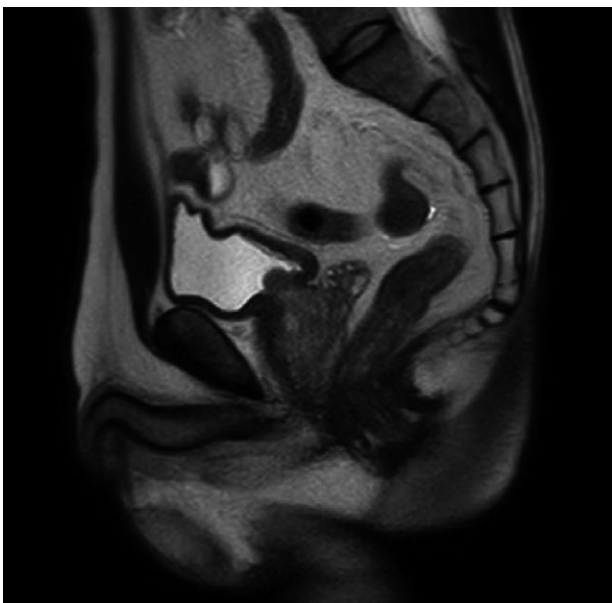


Fig. 3 MRI finding (patient i in Fig. 1) revealed that direct apposition of the posterior bladder wall with edematous mucosa against the enlarged median lobe of the prostate protruding into the bladder.

by hard vertical motion in the empty bladder lumen during running, leading to apposition of the surfaces (Fig. 2). A previous case report also advocated theories of injury from repeated impact of the flaccid bladder posterior wall against the bladder base.⁶ Runners have a higher hematuria prevalence than swimmers or cyclists.^{5,7} Moreover, the bladder neck is more firmly fixed to the pelvic floor by the protruding prostate in men than women. This can explain one of the reasons why all patients were male. In fact, two patients also had benign hypertrophic prostate protruding into the bladder with more than 30 cc estimated prostatic volume (Fig. 3). There have been few reports of running-induced gross hematuria in women. In our study, most patients were relatively young and ran long distances. In fact, there was a significantly higher hematuria incidence in the younger or longer distance runners than in older or shorter distance runners.⁸ Furthermore, half

of patients had gross hematuria relapse after restarting running. Therefore, running without completely voiding the bladder and preventing dehydration by high fluid intake have been recommended to prevent running-induced hematuria. Further studies such as bladder imaging experiments or computerized models simulating pelvic forces during exercise may help confirm our hypotheses in the mechanism of bladder injury.

In contrast, running-induced hematuria was occasionally caused by coexisting urothelial carcinoma or impacted ureteral stone in our study. We should keep this in mind. For the first time, a urological evaluation including cytology and CT scan in addition to cystoscopy is recommended. However, running-induced hematuria caused by traumatic bladder contusion usually has a benign self-limited course. Thus, unnecessary examinations in a long follow-up would have been avoided.

This is the first report in which cystoscopic findings showed that running-induced macroscopic hematuria can be frequently caused by traumatic bladder contusion.

Conflict of interest

The authors declare no conflict of interest.

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