

## Red Bull PET/CT

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### Introduction

Current guidelines recommend to avoid intake of coffee prior to injection of [ $^{18}\text{F}$ ]fluorodeoxyglucose ([ $^{18}\text{F}$ ]FDG), as this may hamper uptake in sites of disease and also increase physiological biodistribution, thereby limiting diagnostic accuracy [1]. Red Bull is nowadays one of the most popular soft drinks with the highest rates of brand usage and brand awareness among all generations [2]. In the present case, we report on an unintentional ingestion of this energy drink right after injection of the radiopharmaceutical, thereby emphasizing the need to inform patients about avoiding intake of these types of beverages not only prior to, but also after tracer injection.

### Case Report

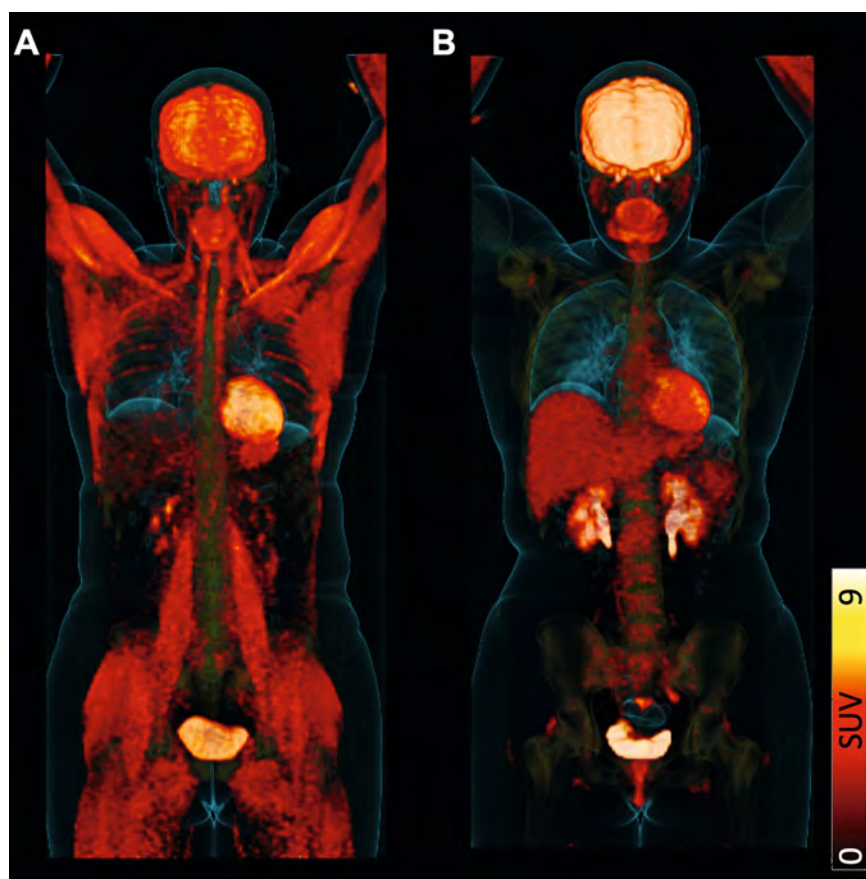
We herein report on a patient with Hodgkin Lymphoma who was scheduled for [ $^{18}\text{F}$ ]FDG PET/CT as part of routine follow-up after treatment with two cycles of chemotherapy and mediastinal external beam radiation. Following current guidelines [1], the patient was advised to stop any sugar or caffeine intake at least 4 h prior to molecular imaging. A blood glucose level of 97 mg/dl was recorded upon arrival at our PET/CT center. As shown on [ $^{18}\text{F}$ ]FDG maximum intensity projection in (A) of ► **Fig. 1**, increased uptake in large muscles along with reduced brain, increased myocardial and almost absent liver uptake was revealed, thereby questioning adherence to the fasting period. The patient then reported on ingestion of an energy drink (Red Bull) right after radiotracer administration. After having strictly followed respective dietary recommendations, the scan was repeated (► **Fig. 1B**), which showed normal [ $^{18}\text{F}$ ]FDG biodistribution and response to treatment.

### Discussion

As one of the most popular energy drinks [2], a 250 ml can of Red Bull consists of

water, sugar (12 g/100 ml), caffeine (80 mg), 2-aminoethanesulfonic acid (taurine, 1000 mg) and glucuronolactone (600 mg) [3, 4] and has been advocated to increase (an)aerobic exercise performance [5]. Given its rather low amount of sugar relative to other energy drinks [6], one may speculate whether additional ingredients may have contributed to the high uptake in skeletal muscles observed in the present case report. For instance, taurine can be involved in muscle contraction by increasing sarcoplasmic reticulum calcium aggregation and release [7]. As muscle fibers adjust their contractility by regulating intracellular levels of taurine [4, 7], elevated blood concentration of

this amino acid after Red Bull intake may also explain increased accumulation of [ $^{18}\text{F}$ ]FDG in the muscles. Nonetheless, it remains unclear how fast taurine is absorbed from the digestive tract or incorporated in muscular cells [4]. As such, beyond potential additive effects of taurine combined with caffeine, the observed high skeletal muscle uptake could also be predominantly explained by caffeine alone [4]. The latter ingredient can lead to increased exercise endurance by preservation of muscle glycogen and neuroendocrine activation [8, 9] and thus, current guidelines also recommend refraining from intake of coffee prior to [ $^{18}\text{F}$ ]FDG PET [1]. Taken together, beyond sugar,



► **Fig. 1** Patient with Hodgkin Lymphoma who was scheduled for [ $^{18}\text{F}$ ]FDG PET/CT. In (A), increased uptake in large muscles along with reduced brain, increased myocardial and almost absent liver uptake was revealed, thereby questioning adherence to the fasting period. The patient then reported on ingestion of an energy drink (Red Bull) right after radiotracer administration. After having strictly followed respective dietary recommendations, the scan was repeated (B), which showed normal [ $^{18}\text{F}$ ]FDG biodistribution and response to treatment.

the excitatory effects caused by taurine, its precursor glucuronolactone, and caffeine may have all contributed to the observed increased uptake in the muscles. Thus, patients should be advised to avoid such beverages not only prior to, but also right after [ $^{18}\text{F}$ ]FDG injection, even if labeled as “sugar-free”, as those drinks may still include the afore-mentioned ingredients potentially causing increased muscular radiotracer accumulation.

## Funding

German Research Foundation (453989101,507803309) | Okayama University (“RECTOR”) | Japan Society for the Promotion of Science (22H03027) | <http://dx.doi.org/10.13039/501100001691>

## Conflict of Interest

The authors declare that they have no conflict of interest.

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Nuklearmedizin 2024; 63: 76–77  
published online December 22, 2023

**DOI** 10.1055/a-2195-0138

**ISSN** 0029-5566

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