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Case Report

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Long-term pneumoperitoneum in continuous ambulatory peritoneal dialysis (CAPD) caused by handling fault of Stay.Safe® system associated to bicaVera solution

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Abstract
We found chronic pneumoperitoneum in two continuous ambulatory peritoneal dialysis patients from two different hospitals. Both patients used the Stay.Safe® system and bicaVera solution, whose extension tubing is not primed with fluid but air-filled, unlike that of the conventional solution bags. This fact, together with a handling fault common to both patients, resulted in the inflow of the air in the tubing of bicaVera bags into the peritoneal cavity during every exchange. We warn of this complication, which must be specifically pointed out during training, and we recommend providing the system with a mechanic device to prevent this handling fault.

Keywords: balance; bicaVera; peritoneal dialysis; pneumoperitoneum; Stay.Safe®

Introduction

Stay.Safe® (Fresenius Medical Care Deutschland GmbH, Bad Homburg, Germany) is a double-bag CAPD system with Y-tubing and 'flush-before-fill' system, with a design that guarantees asepsy by avoiding any contact between the patient and the connections. Recently, this system has incorporated the option of using the new solutions bicaVera and Balance, with neutral pH, low content of glucose degradation products and different proportion of bicarbonate, which are expected to improve peritoneal dialysis (PD) outcome over the classical lactate-based solutions. We report a problem that has arisen with the use of the new bicaVera solution bags. This problem took place in two different hospitals and therefore it might affect others.

Patient 1

A 42-year-old woman with end-stage renal disease of unknown origin began continuous ambulatory PD (CAPD) in July 2008 with the Stay.Safe® system and 3 × 2 L bicaVera. Two months later, she was admitted because of colicky abdominal pain that disappeared spontaneously in a few hours and was envisaged as tympanites. Six months after initiating CAPD, a routine chest X-ray disclosed a huge pneumoperitoneum (Figure 1A). There were neither symptoms nor signs on the physical exam other than tympanic percussion such as we usually find in CAPD patients. The pneumoperitoneum was emptied almost completely with a drainage in forced Trendelemburg position.

Patient 2

A 68-year-old man with diabetes mellitus and end-stage renal failure was placed on CAPD in June 2008 with Stay.Safe® system and 3 × 2 L bicaVera. Seven, eight and eleven months after initiation of CAPD, he presented slightly cloudy effluent with 124–435 cells/μL with 3–23% neutrophils and 20–40% eosinophils, without symptoms. He never presented any other complaints or complications. In May 2009, a routine chest X-ray disclosed a small pneumoperitoneum. Clinical evaluation did not identify its origin and no action was taken. His following radiographic control in December 2009 showed a larger pneumoperitoneum (Figure 1B). Once its cause was

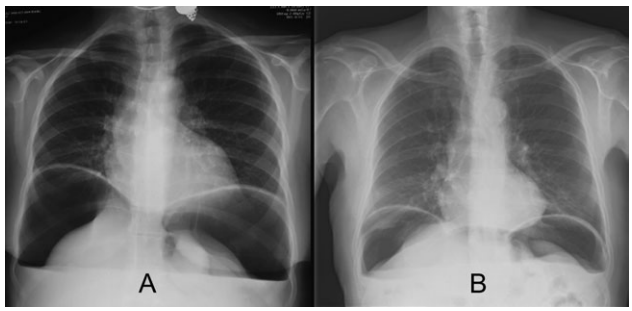

Fig. 1. (**A**) Patient 1. (**B**) Patient 2.

corrected (see below), the air was spontaneously reabsorbed with complete resolution in 5 weeks.

Explanation

Pneumoperitoneum chronicity was assessed in Patient 1 after a re-examination of her 'normal' supine abdomen X-ray in the 'tympanites' episode and in Patient 2 by the reconsideration of his successive eosinophilic peritonitis episodes. This condition, defined as a predominance of eosinophils in the peritoneal fluid, is a well-known effect of pneumoperitoneum [1, 2].

Pneumoperitoneum is a sign characteristically associated to PD from the times of bottled solutions and disposable catheters [3] to the latest CAPD or automated PD systems [4], although its incidence has dropped from >30% to 4–7% [3, 5–9]. Visceral perforation causes <10% of the cases but its early diagnosis is more difficult in PD. Almost a third of such cases are seen after surgery, laparoscopy or catheter or line manipulation. The rest of the cases are attributable to accidental air infusion from bags or lines caused by faulty handling during exchanges or by a fault in dialysis material or catheter [3–11]. This sign is seen in asymptomatic patients and also during contamination peritonitis [7, 9–11] which could have the same origin that caused the pneumoperitoneum—faulty technique or material.

A pneumoperitoneum as severe as the one, shown in Figure 1, is exceptional in CAPD, and the simultaneous coincidence of two such cases is extraordinary. In order to discover its origin, we focused on the material and the procedure of the exchanges performed by the patients. Both patients used the Stay.Safe® system, which was utilized in both hospitals, since this complication had never before been encountered. Also, both patients had used the recently implanted bicaVera bags as well. We compared the bicaVera and Balance bags with the conventional lactate solution bags used so far and we discovered a significant difference between them (Figure 2A). Whereas in the conventional solution bags, the infusion tubing, with a capacity of around 35 mL, is pre-filled with dialysis solution, in the new bicaVera and Balance bags, this tubing is empty, with no dialysis solution and air-filled. Correct handling was evaluated by the nursing staff and the same defect in the procedure was discovered in both patients: they rotated the disc roulette (Figure 2B) too quickly from drainage, Stage 1, to peritoneal filling, Stage 3, without the required 5 s stop in the flush-before-fill, Stage 2, as is required in the system instructions and as all patients are required to do when being trained in its use. This handling fault would not had remarkable consequences with the conventional bags, but with the new bicaVera and Balance bags, the air in the tubes was able to flow into the peritoneal cavity during every exchange, increasing and perpetuating a chronic pneumoperitoneum.

Once the origin of pneumoperitoneum was discovered, we expected the problem would be solved by retraining the patients. But human nature is not so simple, and although patients were specifically retrained and we continuously pointed out that problem, we were surprised that Patient 1 developed another small pneumoperitoneum a few months later. She confessed that she sometimes made the same mistake whenever she was in a hurry.

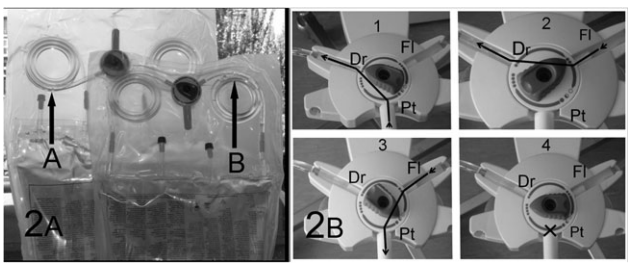

Fig. 2. (**2A**) The bags are vertically placed. One can observe that the coiled tube of the bicaVera bag (A) is full of air (a few liquid drops lie on the lower part), unlike the conventional bag tube (B), pre-filled with liquid (a few air bubbles float in the upper part). (**2B**) Stay.Safe® disc system. Pt, patient catheter; Dr, drainage bag; Fl, dialysis solution bag. The Stay.Safe® system wheel requries the stages in the exchange to be followed exactly, step by step: (1) peritoneal drainage, (2) flush-before-fill, (3) peritoneal filling and (4) catheter closing previous to disconnection. As there is no mechanic obstacle to continue from step 1 to 3 without stopping at step 2, our patients went through this stage too quickly producing air inflow from the tubes into the peritoneal cavity in every exchange.

Conclusion

The large pneumoperitoneum observed in two patients from two different hospitals must be ascribed to the patients' misuse of the Stay.Safe® system and/or to deficiencies in their training by the nursing staff. But we also think that such complications are favoured by the differences between the new bicaVera and Balance bags and the conventional solution bags and by the fact that the Stay.Safe® system compels patients to follow the exchange procedure step by step, but it does not avoid springing from drainage to filling too quickly without stopping in the intermediate flushing stage. Therefore, we must firstly insist on the relevance of training to eliminate air from the tubing in all systems with flush-before-fill systems. Secondly, note that these cases could have been avoided if PD patients periodic reviews of procedures and retraining had been carried out in PD patients as guidlines advise. And thirdly, the relapse of Patient 1 tells us that sometimes good training may not be enough, and manufacturers must instigate more and more barriers to prevent faulty handling of PD systems. Consequently, in our case, the disc of the Stay.Safe® system should be modified so that it forces the patient to stop for a minimum period of time during Stage 2 (flushing).

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