



## Case Report

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# Missing Part in Adjustable Pressure Limiting Valve in Bain's Circuit: A Near Miss

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## ABSTRACT

Breathing circuits are the delivery systems which conduct anesthetic gases from an anesthetic machine to the patient. They are designed for either spontaneous respiration or intermittent positive pressure ventilation (IPPV). The Bain co-axial circuit, a modification of Mapleson D system is the most commonly used circuit outside operating room procedures. It has several advantages over the circle system in that it is light-weight, convenient with adjustable length. Although most problems with the circuit involve disconnections, obstruction problems related to kinks in the gas delivery tube or foreign body in the elbow have been reported. We would like to report an anesthetic incident involving desaturation of patient posted for electro convulsive therapy (ECT) due to missing part of the Adjustable Pressure Limiting (APL) valve.

### Keywords:

Bains circuit, Adjustable pressure limiting valve malfunction

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## Introduction

**T**he Bain circuit is a modification of the Mapleson D system in which fresh gas flow is delivered near the patient end through a small inner tube located within a larger clear corrugated tube. The major disadvantage is the requirement of high gas flow rates to prevent re-breathing. The basic parts of a circuit consist of a reservoir bag, anaesthetic tubing, and in most cases a pressure relief valve. (Fig. 1). Adjustable Pressure Limiting Valve provides good pressure adjustment while ventilating the patient manually. Valve response is gradual and linear enabling to make fine pressure control. Pressure relief mechanism is in-built for patient safety, intended to provide pressure control in the breathing circuit during manual bag ventilation. Continuous positive airway pressure or positive end-expiratory pressure is added to the circuit by partially closing the valve during spontaneous or assisted ventilation, respectively. [1]

## Case Presentation

A patient in his 30's, was diagnosed with schizophrenia and posted for first session of ECT. The indication for ECT was aggression and resistance to medication. Past medical history was noncontributory with respect to cardio-pulmonary disease. The patient had no known allergies. His medication history included Divalproex sodium 500mg od, tab. Risperidone and trihexyphenidyl bd, tab. Haloperidol 10mg at night. There was no family history of anaesthetic complications. The chest was clear to auscultation. Heart sounds were clear, no murmur.

Patient was kept on nil per oral for 8 hours. Drugs were prepared and kept ready. Bain's circuit was connected to anesthesia machine and checked. Circuit was free of leak, inner tube appeared patent except for slow filling of the reservoir bag. All the emergency drugs and equipment were kept ready. Ambu bag was checked and kept ready. Patient was preoxygenated with 100% Oxygen. Inj. Glycopyrrolate 0.2mg, inj. Thiopentone 150 mg, inj. Succinylcholine 50 mg were given. Mouth gag was placed and ECT was given. Seizure lasted for 30 seconds after which mouth gag was removed and mask ventilation was attempted. APL valve was closed fully but there was no adequate filling of the reservoir bag. Oxygen flow from the machine was present. However, patient started to desaturate with SpO<sub>2</sub> falling to 80. Ambu bag was connected to oxygen and ventilation was started. Saturation started improving and SpO<sub>2</sub> was maintained at around 95. After 4 minutes spontaneous breathing efforts were present and patient was connected to Hudson mask. Bains circuit

was examined for non-filling of the reservoir bag. Inner tubes were intact. On opening the APL valve, it was found that the spring attached to the APL valve was missing causing air leak even with full closure of the valve. (Fig. 2). Patient's vitals were observed in the recovery room for 2 hours. After 2 hours, patient was conscious, obeying commands and moved to the ward.



Fig. 1. Functional APL Valve

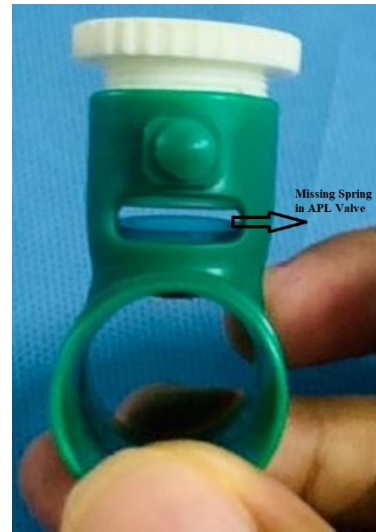


Fig. 2. APL Valve with Missing part

## Discussion

Modification of Mapleson D circuit popularly known as Bain’s circuit is widely used in procedures outside the operation theatre- shifting of patients on ventilator for taking images. Most problems associated with using Bain circuit so far reported include disconnection or kinking of the inner tube [2], obstruction problems related to kinks in the gas delivery tube [3] or foreign body in the elbow. [4] In our case, the spring present in the APL valve was found missing. Though there was no leak in the inner tube and there was a slow filling of the reservoir bag, the problem was not appreciated when the patient was on spontaneous respiration. Difficulty arose when controlled ventilation was attempted in which the reservoir bag was not filling adequately to ventilate the patient. On examination of the Bain’s circuit, the outer and inner tube were found patent without kink. On visual inspection of APL valve, it was found that the spring present in the valve was missing. Several tests have been described to assess any co-axial circuit malfunction; these include:

1. Visual inspection of tubing for any obvious disruption or obstruction.
2. Pethick test: This tests the low-pressure systems and the integrity of the inner tube. The procedure is as follows: Occlude the patient end of the circuit. Close the adjustable pressure limiting valve. Fill the circuit using the oxygen flush valve. Release the occlusion at the patient end and flush. Collapse of the reservoir bag due to the creation of venturi effect in the outer tube is an indication that the inner tube is intact. This test will not detect a system in which inner tube is omitted or does not extend to the patient port or one that has holes at the patient end of the inner tube.
3. Foex-Crampton-Smith manoeuvre: This manoeuvre assesses the gas flow line from the flowmeters of the machine to the patient end of the circuit. With an oxygen flow at 2 litres/minute, the patient end of the inner tube is occluded

briefly for 2–3 seconds using the forefinger. A positive test is indicated by descent of the rotameter bobbin due to back pressure; with removal of finger, the bobbin ascends to its original position. Ghani suggested the use of the plunger of a 3-ml syringe to occlude the inner tube more precisely. [5] The probable reason for the missing parts may be that during the disinfection of the circuit after every use, reassembly was flawed. The testing of Bain’s circuit should also include a visual inspection of the APL valve. The learning points acquired from this case are:

- The slow filling of the reservoir bag should not be taken lightly which would have caused serious hypoxic complication,
- Visual inspection of APL valve should also be done.
- Even when the patient is desaturating, we can maintain saturation with simple ambu mask ventilation.

## Ethical Considerations

### Compliance with ethical guidelines

Informed consent was obtained from the patient for publishing the case report

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### Conflict of interest

The authors declared no conflict of interest

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