

## CASE REPORTS

### A CASE OF INSPIRATORY VALVE LEAK IN A PRESSURE BREATHING MASK (A13A1)

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On 3rd December 1960 a Flying Officer was asked to lead a cross-country formation of four Hunter aircraft. As this was his first cross-country on this aircraft, and as he was the formation leader, he felt apprehensive.

This apprehension was further increased, when two out of the four aircraft had to return to base shortly after take off, due to mechanical defects, and during flight, when he noticed that one of the gauges of his fuel tanks showed empty. The subsequent events are described in the officer's own words as follows:

"On the 3rd December, 1960, I was authorised to fly a Hunter as Red 2 in a cross-country formation.

After climbing to 38,000 ft. (indicated), I felt a funny sensation which, since my mask was leaking, I thought could be due to lack of oxygen. I tightened the mask fully and checked the oxygen system and connections.

The oxygen system was functioning normally. Since the mask was still leaking, I selected the 'toggle harness' to emergency. The mask still leaked, but I had to blow very hard to exhale. I checked myself for hyperventilation, but found I was breathing normally. The colour of my finger nails was pink.

Suspecting that the breather valve of mask was stuck, I tried to clear it, but without success. In the meanwhile we were flying at 42,000 ft. (indicated) with the cabin pressure showing 22,500 ft. I asked Red to descend to 38,000 ft., which we did. Shortly afterwards we saw our destination ahead and I peeled off and landed normally. My chest was very tired because of continuously blowing out. About 15 or 20 minutes after switching off the aircraft, I lit a cigarette in the flight office. After that, I started feeling faint and reported to the M. I. Room.

At no stage did I lose consciousness, either in the air or on the ground. The night before the flight, I did not eat a proper dinner, nor did I take breakfast before flying, as I thought that I would have it on arrival at my destination."

### Clinical Picture

At 14.10 hours the officer reported to his unit Medical Officer, complaining of dryness of the throat, weakness and a fainting feeling.

The unit Medical Officer noted that he was looking extremely exhausted. He answered questions intelligently. His conjunctivae were congested. The pulse rate was 108 per minute. Blood Pressure 120/66 mm Hg. The tongue was dry. The chest moved regularly and equally, but the breath sounds were vesicular in type, with scattered ronchi all over the left side of the chest. Heart sounds were rapid but the rhythm was regular. Pupils were equal and reacting normally. All other systems were normal.

He was given pethidine hydrochloride 50 mgm I. M. stat, oxygen inhalation and glucose sips.

At 14.40 hours, he complained of difficulty in breathing and cramps in the calf of the left leg. Pulse rate was 95 per minute. Blood Pressure 120/60 mm Hg. Respiration 32 per minute. On auscultation the lungs appeared clearing. Ronchi were restricted to the left base.

At 15.15 hours he was admitted to the local service hospital, where he was given fluids and observed. He had slight discomfort at night, the pulse rate was 88 per minute, and the feeling of weakness persisted. Next morning his breath sounds were normal. Pulse and respiration were 78 and 20 per minute respectively, and the blood pressure was 125/82 mm Hg.

### Investigations

- 5-12-60 ... *Urine* : Reaction : Acid.  
 Albumin and Sugar : Not detected.  
 Deposits : Pus cells 1/HPF.  
 A few crystals of calcium oxalate seen. No RBC or cast seen.
- 5-12-60 ... *E. C. G.* : (1) S waves in leads V1-V7  
 (2) Inverted P & T waves in leads AVL otherwise — NAD.
- 5-12-60 ... *Stool* : No abnormality detected.  
*Fasting Blood Sugar* : 95 mgm/100 ml.  
*Blood* : *ESR* : 4 mm fall in 1st hour.  
 (Wintrobe's method).
- 10-12-60 ... *Blood* : Hb : 16.2 gms%  
 WBC : 6,200 per cmm of blood.  
 DLC : Poly 59%, Lympho 35%  
 Mono 2%, Eosino 4%.

CASE REPORTS

71

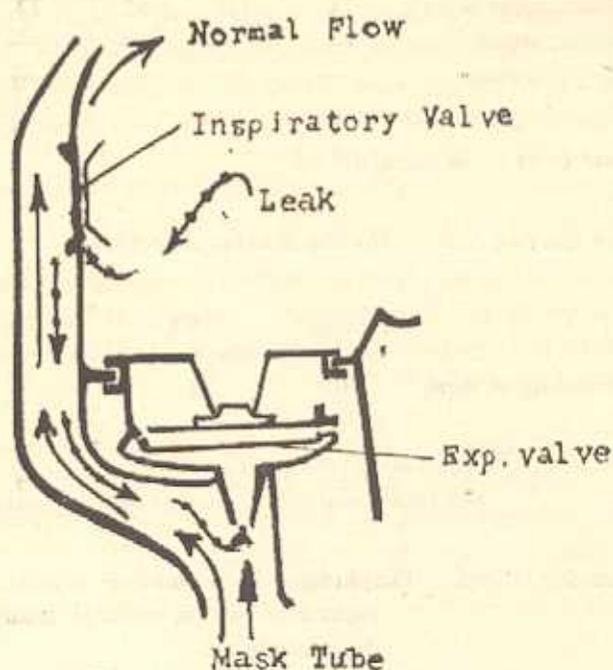
16-12-60	...	G. T. T.:	Fasting	½ hr.	1 hr.	1½ hrs.	2 hrs.	2½ hrs.
		Blood sugar mgm%	74	118	92	77	76	74
		Urine: sugar	—	—	—	—	—	—
		acetone	—	—	—	—	—	—
21-12-60	...	Blood Urea: 38 mgm/100 ml.						
21-12-60	...	Liver function tests: No abnormality detected.						
21-12-60	...	G. T. T.:	Fasting	1½ hrs after breakfast	3 hrs.	5 hrs.		
		Blood sugar mgm %	105	91	77	76		
21-12-60	...	E. C. G.: Normal R. wave raised in AVR. No ventricular stress. Sinus rhythm maintained.						
23-12-60	...	Screening Chest: Diaphragm level outline normal. Movements and excursions within normal limits in ordinary and deep breathing.						
30-12-60	...	Respiratory Efficiency:						
		Vital capacity: 3,800 ml.						
		Tidal volume: 500 ml.						
		Functional effective ventilation: within normal limits. No air trappings.						

On 3rd January, 1961, no organic cause having been established by the medical specialist, the officer was discharged from hospital. He was recommended a restricted flying category and further observation for a period of three months.

The officer reported to the Air Force School of Aviation Medicine for a Medical Board on 13-1-61. After a thorough interrogation and carefully reviewing the case history, the incident on 3rd December, 1960, was attributed to a leak in inspiratory valve on the following evidence:

1. A subjective feeling of a leak in the mask arises from the sensation of air/oxygen escaping from under the margins of the oxygen mask and flowing over the cheeks and the nose. On interrogation, it was confirmed that this sensation was felt during expiration. This leakage of oxygen from the mask during expiration is explained by a leak in the inspiratory valve, which prevents opening of the expiratory valve; the only way, therefore, expired air can escape is by lifting the mask off the face. (Fig. 1)

FIG. 1



2. The 'funny sensation' referred to by the pilot was in the form of a vague discomfort and a feeling of distress. This could have been due to apprehension, associated with the thought of an inadequate mask fit. This was superimposed on the apprehension the pilot already had of the sortie.
3. The main symptom during flight, was extreme difficulty in exhaling. This difficulty suggests an obstruction to outflow of expired air, and its appearance, after tightening the mask by the toggle harness, is a strong evidence in favour of the expiratory valve not opening.
4. Symptoms of exhaustion, weakness, fainting sensation, conjunctival congestion and loss of power in the limbs can be explained by the intense muscular effort required during expiration, and the fluid shifts brought about by high intrapulmonic pressures during expiration.
5. When the officer was fitted with an A13A1 mask, in which the inspiratory valve was deliberately made leaky, and asked to breathe, he spontaneously remarked, "This is *exactly* what I had experienced in the air". He was pleased with this demonstration, as it helped to convince him that his symptoms were not due to any disease, and he was relieved of the fear of recurrence of the episode,

### Comments

This case illustrates the importance of oxygen equipment in aircraft, the need for regular checks of oxygen masks to ensure proper functioning particularly of the inspiratory and expiratory valves. It brings out the importance of thorough indoctrination of aircrew in the use of oxygen equipment, the need to check regularly that oxygen masks are satisfactorily functioning, and that there is no leak or blockage in the valves. It also emphasises the importance of a thorough investigation of the personal safety equipment of aircrew by the Medical Officer after the flight incidents of this nature.

Improper care of the oxygen mask can result in a leaky inspiratory valve. It is easy for a dust particle to find its way underneath the rubber flap of the valve. We have been able to produce a leak in the inspiratory valve by exposing the oxygen mask to a small amount of ash from a cigarette.

Flying with a leaky inspiratory valve is not without danger. Apart from discomfort, distraction and apprehension caused by it, there is risk of loss of consciousness due to interference with the return of blood to the heart, caused by high intra-thoracic pressure during forced expiration.

It is fortunate that the above incident did not have more serious consequences.

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