Patient Transport Unit for Aeromedical Evacuation

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Introduction

Inter-hospital transport of critically ill patients is associated with potentially adverse events [1]. Environmental conditions of altitude, noise and vibration during aeromedical evacuation pose additional challenges [2]. Current policy dictates that a patient must be stable before evacuation [3]. This not only increases the burden at the smaller hospitals but also delays definitive treatment and rehabilitation available at the tertiary care centres.

The concept of air evacuation of critically ill patients with 'on-board' monitoring and resuscitation is gaining popularity [4]. The miniature ventilators and light weight monitoring equipments are widely available for transportation of critically ill patients. However, the limitations of aeromedical evacuation are oxygen requirements of the patient and power supply for the ventilator and monitors. Oxygen and power supply can be tapped from the aircraft. However, most fixed wing transport and large rotary wing aircraft provide electrical current at voltages and frequencies which are not compatible with medical equipment. In addition they do not carry adequate oxygen reserves on board. Major modifications are therefore required in an aircraft to render it suitable for aeromedical evacuation. A self contained patient transport unit with its own power and oxygen supply is a more feasible option. Improved safety during air evacuation can be better ensured when such a unit is operated by medical personnel trained to recognise the effects of the hypoxic, hypobaric flight environment on various organ systems.

A Patient Transport Unit Designed at this Hospital

A standard trauma care emergency and recovery hospital trolley has been modified and reinforced to house a portable ventilator, a multiparameter monitor, a defibrillator and two infusion pumps (Fig. 1). A suction

unit is carried separately. The ventilator used delivers the set tidal volume upto an altitude of 15000 feet. Since the cabin altitude of transport aircraft does not exceed 8000 to 10000 feet, the ventilator is suitable for aeromedical evacuation. It can also provide positive end expiratory pressure to patients who become hypoxemic in flight despite 100% oxygen. The base of the trolley accommodates the universal power supply (UPS) system and one 1246 litre oxygen cylinder. A standby cylinder is carried separately. The UPS system consists of two 800VA inverters powered by two 180 VH lead acid batteries and provides power supply for six hours.

Our Experience

Three patients, a case of cervical cord injury with quadriplegia on invasive ventilatory support, a case of 80% burns and a post operative case of polytrauma with fracture pelvis, laceration liver and rupture urethra have been successfully evacuated by air from a zonal hospital to a tertiary care centre, a flight of about three hours. Current limitations of the patient transport unit are its weight, use of lead acid batteries and compressed oxygen cylinders which do not conform to flight safety

Fig. 1 : Patient transport unit

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Fig. 2: UPS based power supply trolley. Total weight 300 kg

regulations. The weight of the patient transport unit with its self contained oxygen and power supply and medical equipment is 150 Kg.

Future Modifications

The weight of the patient transport unit can be significantly reduced if the battery and the oxygen bank can be housed in separate castor mounted units. A project to exclusively utilise Nickel-Cadmium alkaline batteries and oxygen cylinders made of steel braided with fibre glass of AN-32 aircraft is presently under study. AN-32 aircraft alkaline batteries are rated for 24 V 25 AH and are suitable for use with a commercially available 2 KVA sine wave UPS. Seven such batteries would last for four hours. Four oxygen bottles of 10 litres capacity when charged to 2100 PSI will have 4800 L of oxygen which would last from 4 to 8 hours depending upon the fraction of inspired oxygen used. Fig. 2 depicts the UPS based power supply trolley with its weight and dimensions. Fig. 3 shows the schematic diagram of the oxygen bank. This patient transport unit with its oxygen and battery bank can be retrofitted in the currently used transport aircraft and large helicopters of the Indian Air Force.

Conclusion

The patient transport system is a stand alone critical

Fig. 3: Schematic diagram-oxygen bank

care platform that integrates a combination of commonly used medical devices. The concept of the system is to provide high quality life-sustaining care even when evacuation distances are increased.

Conflicts of Interest

None identified

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