INTERNATIONAL TRAUMA LIFE SUPPORT

PREHOSPITAL EMS MANAGEMENT OF OPEN PNEUMOTHORAX USING CHEST SEALS

The guidelines and references contained in this document are current as of the date of publication and in no way replace physician medical oversight.

INTRODUCTION

An open pneumothorax occurs when there is a pneumothorax associated with a chest wall defect such that the pneumothorax communicates with the exterior. Penetrating chest trauma with lung perforation accounts for 5-6% of battlefield injuries.[1] Open pneumothorax is encountered more frequently in military trauma but is rare in civilian trauma, with only 31 cases reported to the Trauma and Research Network in the UK in an 8-year period to 2013.[2] It is well recognized as one of the preventable causes of trauma death.[3]

Air tends to follow the path of least resistance; as such, if the opening in the chest wall is approximately two-thirds of the diameter of the trachea or greater, air passes preferentially through the chest wall defect than the trachea with each respiratory effort.[3] Effective ventilation is thereby impaired, leading to hypoxia and hypercarbia.

The diagnosis of an open pneumothorax is based on the history and the clinical finding of a wound on the chest wall that is sucking air into the chest and visibly bubbling with evidence of an underlying pneumothorax.[2]

A chest seal is one of the current recommendations for management in the prehospital setting.[2,4]

BACKGROUND

Chest seals for prehospital use may be vented or unvented. A number of different vented chest seals are available commercially with differing performance in terms of their adherence to skin and intrathoracic pressure relief.

The current 8th Edition ITLS Provider manual recommends the use of a chest seal with an exhaust valve, such as an Asherman chest seal, Bolin chest seal or Halo vent.[4]

Until recently, the Bolin chest seal and Asherman chest seal were the only two vented chest seals available. Recently, novel chest seals have been developed with a different type, shape, material and valves to enhance the evacuation of air, and possibly blood, from the pleural cavity. Furthermore, such chest seals were intended to avoid obstruction of the valve by external environmental artifacts or blood clots.

Arnaud reported that Asherman chest seals very easily peel off in wet skin.[5,6] Similarly, Bolin chest seals are easier to peel off compared to other chest seals such as SAM, HyFin and Russell.

In addition to adherence, the efficiency of the vent has also been identified as a factor to consider in determining the overall efficacy of a chest seal.

CONSIDERATIONS

The performance of chest seals to prevent tension physiology depends partially on their ability to adhere to the skin and seal the chest wound. There are no human studies, but a number of animal studies have been published to assess the efficacy of the range of chest seals that are currently available for use.[5,6,7,8,9] These are generally aimed at assessing adhesiveness and venting function in the presence of fluid, hence assessing prevention of tension physiology.

In assessing adhesiveness, eight vented chest seals were tested with adherence scores for peeling and detachment scores at ambient temperatures.[2] Five were further selected based on their superior adherence scores and assessed after 17 hours of storage at extreme cold (-19.5C) and hot (71.5C) temperatures. No significant difference was found in skin adherence of the five vented chest seals at ambient temperature; four seals (Russell, FastBreathe, Hyfin, and SAM) maintained superior adherence even after exposure to extreme temperatures compared to the Bolin chest seal.

In assessing venting function, the beneficial effects of application of five non-occlusive chest seals for management of hemopneumothorax and prevention of tension hemopneumothorax were evaluated in a swine model with an open bleeding chest wound.[7] It was established that covering a dry (non-bleeding) chest wound with any of the chest seals restored normal intrapleural pressure and improved respiration. However, subsequent blood exuding from the wound site did not pass through the one-way valve chest seals. Accumulated blood clogged the air passage and led either to development of tension hemopneumothorax, or more often, caused detachment of chest seals from skin and loss of its function. Conversely, the laminated vent channel on other chest seals allowed effective evacuation of blood and air from the pleural cavity and prevented tension hemopneumothorax. Laminated vent channels were also instrumental in preventing adhesive failure because blood did not accumulate behind the chest seals. Although further investigation is warranted for clinical field application, the authors

recommend in the interim that chest seals with laminar vent channel be used preferably for treating combat casualties in the field, particularly prior to the arrival to higher level of care.

PROCEDURE

Based on local protocols, **vented chest seals** fitted with a laminated vent channel should be applied to patients with open pneumothorax.

MEDICAL OVERSIGHT

Medical oversight should continue to review current literature and develop proper prehospital EMS protocols in regard to appropriate use of chest seal. Implementation of this protocol should be monitored and supervised through a quality assurance program.

CONCLUSION

It is the position of ITLS that there is sufficient evidence to support the use of vented chest seals, which have laminated vents, in patients with open pneumothorax. In the event that a chest seal with a one-way valve is used, the valve should be checked or the seal changed 1 hour after application.

Recent advances in the design and manufacture of chest seals have led to the availability of the H-vent chest seal on the market. ITLS will continue to monitor further clinical field studies and will update this position as necessary.

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Current Thinking

Prehospital EMS Management of Open Pneumothorax Using Chest Seals

International Trauma Life Support

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Abstract

This is the current thinking of International Trauma Life Support (ITLS) with regard to the type of chest seal utilized in the management of open pneumothorax in the prehospital setting.

Current Thinking

It is the position of International Trauma Life Support that:

1. There is sufficient evidence to support the use of a **vented** chest seal by prehospital EMS providers in the management of an open pneumothorax patient.
2. Based on currently available literature and evidence from animal studies, ITLS supports the use of a vented chest seal with a laminated vent channel within the framework of established system medical oversight and protocols.
3. The standard operating procedure in the use of a vented chest seal with a one-way valve should include a check or change after 1 hour of application, to recognize the pooling or clotting of blood which, if not addressed, will result in valve failure.

