Biomedical Innovation Competitor #2

SmartDrain

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Video: https://w21cinnovationacademy.com/competitors/#Competitor6

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The device facilitates chest tube placement, combining depth control and ability to detect entry into the body cavity during insertion. The sharp central tip facilitates penetration of the chest wall. The device resembles a screw and advances into the chest through clockwise rotation, providing precise depth control. The tip also contains an electrical impedance manometer to alert when the pleural space has been breached. On entering the desired cavity, the central piece is removed from the screw-like body which remains on the chest wall. The device thus forms a conduit between the chest cavity and exterior for chest tube insertion.

Pneumothorax is a significant global health problem with an estimated incidence of up to 2 million events per year globally. About 13% of penetrating wounds to the thoracic cavity require intervention. The complication rate from chest tube insertion can be as high as 30% from puncture of lung or other organs. These thoracic injuries can contribute up to 30% of deaths. Treatment of the symptomatic pneumothorax requires urgent insertion of an intercostal drain that can be safely inserted by skilled/highly trained medical practitioners as well as first responders with limited medical skills both in and out of the hospital setting.

Conventional 'surgical' chest tube insertion involves incision of the skin and blunt dissection of the chest wall until the clinician penetrates the chest cavity and 'feels' a loss of resistance. This method can result in either under penetration (chest tube will not enter the thoracic cavity to evacuate the pneumothorax) or over-penetration (chest tube punctures or lacerates internal organs). Newer techniques involve the passage of the dilator and tube over a guidewire, the operator applies push/force to the needle and dilator as it advances into the thoracic cavity. This risks overshooting the cavity and injuring other organs. There is currently no method of finely adjusting the depth of the needle penetration except by forward pressure. The novelty of this device lies in its ability to provide users, depth control and cavity detection during insertion. Depth control: The advancement of the sharp tip is limited by the clockwise rotation of the external sheath. The outer sheath consists of a base flange and external thread. The flange allows the user to apply insertion and rotational torque to the apparatus. The non-cutting external thread, when rotated clockwise, will direct the sheath forward while anti-clockwise rotation will direct the sheath backward while separating rather than cutting tissue. The angle, and pitch of the thread allow control of the depth of the penetrating tip of apparatus in the chest wall with inserting and rotational torque applied to the flange. The inner wall of the sheath is smooth except for the proximal locking port to lock the inner cannula to the outer sheath. Cavity detection: Current specifications are for impedance detection of air in the pleural space but the apparatus can be adjusted to detect pleural fluid. Future applications could include the employment of our device to drain pleural effusions, chylothorax, empyemas, and hemothorax. This device may be used in the minimally invasive surgical setting to secure a safe entry site into the abdomen (laparoscopy), thorax (thoracoscopy), or joint spaces

(arthroscopy). Sensitivity and threshold impedance can be altered to differentiate fluid, soft tissue (muscle and fat), and solid organs (e.g. liver, spleen, bowel, lung).

This device has been designed for use by both medical practitioners as well as first responders with more limited medical skills both in and out of the hospital setting. The device is compact, portable and can be easily inserted to relieve potentially life-threatening collections of fluid or gas within the chest cavity. This device is anticipated to be most valuable in settings where highly skilled personnel may not be available to provide this lifesaving intervention. Ready application is anticipated by paramedics responding to motor vehicle accidents, military personnel with penetrating injuries, aviation, and marine environments.