ResQGARD™

Impedance Threshold Device

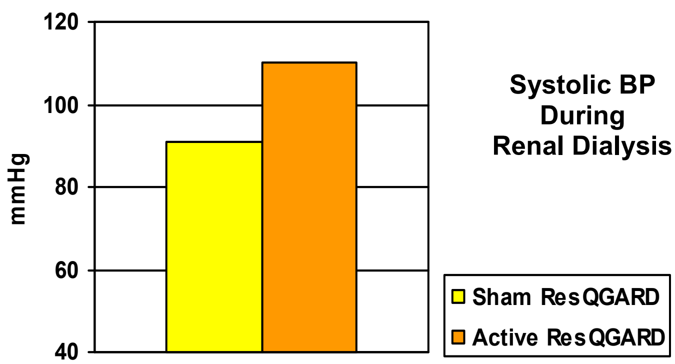
July 2008

KEY STUDY SUMMARY

Studies have shown that hypotensive patients have a significantly higher morbidity and mortality.(31-32) Inspiration through therapeutic resistance (impedance) enhances blood flow by increasing blood return to the heart (preload). An impedance threshold device (ITD) harnesses these natural reflexes and can be used in a variety of clinical settings to enhance circulation when blood pressure is too low. Animal (12-15,17,21,25,27,29,30) and clinical (2,4-11,18-20,22-24,28) studies have shown that the ResQGARD™ ITD works rapidly and non-invasively to increase blood pressure during hypotension from a variety of causes (e.g. hypovolemia, orthostatic intolerance, heat shock, blood donation and dialysis). (References on back)

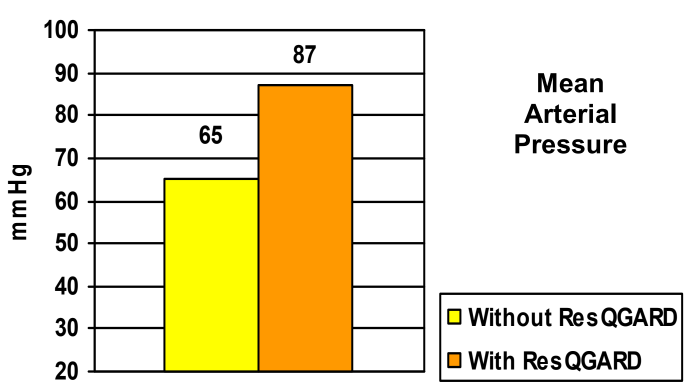
CLINICAL STUDY: INTRADIALYTIC HYPOTENSION

Approximately 25% of patients undergoing chronic renal dialysis develop intradialytic hypotension. One clinical study (3; Convertino et al. *J Grav Phys 2005*) demonstrated that when dialysis patients (n=12) became hypotensive, breathing through an active (functional) ITD for 5 - 10 minutes resulted in significant increases in systolic, diastolic and mean arterial pressures compared to a sham (placebo) ITD (p<0.001).



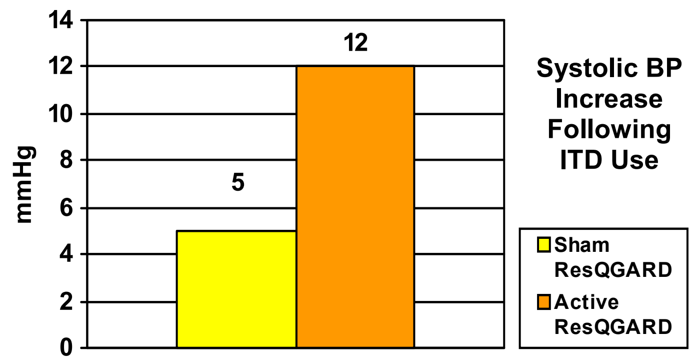
CLINICAL STUDY: HYPOVOLEMIA

Another study (8; Convertino et al. *Crit Care Med 2007*) showed that patients (n=9) subjected to lower body negative pressure (to simulate blood loss) benefited more from an active versus sham ITD. When patients experienced a simulated cardiovascular collapse condition, mean arterial pressures during treatment with an active ITD were 34% higher in patients being treated with an active ITD (p<0.02).



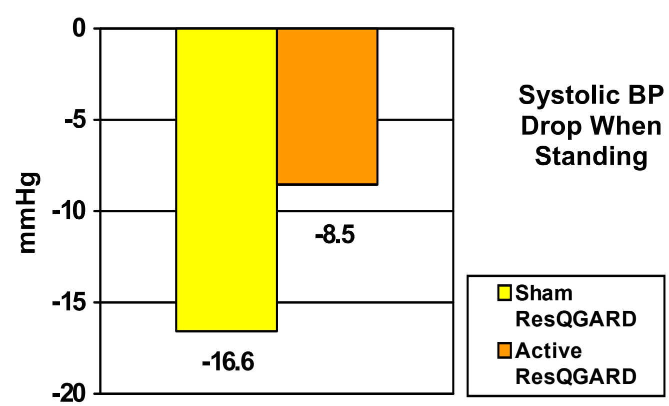
CLINICAL STUDY: HYPOTENSION IN THE EMERGENCY DEPARTMENT

In a third study (28; Smith et al. *Circulation 2006*) of patients presenting to the emergency department with hypotension (≈ 95 mmHg), those patients treated with an active ITD (n=15) had significant improvement in systolic BP when compared to those treated with a sham ITD (n=18) (p<0.01).



CLINICAL STUDY: OTHROSTATIC HYPOTENSION

Use of an ITD in hypotensive, spontaneously breathing humans increases blood pressure and cardiac output and can be used to prevent or delay the onset of hypotension in patients with orthostatic hypotension (OH). In one study (19; Melby et al. *Heart Rhythm 2007*), orthostatic-intolerant patients (n=22) went from a supine to upright position and were treated with both an active or sham ITD. Patients had less change in systolic BP when treated with an active vs. sham ITD (p=0.001).



Other clinical trails have shown that the ITD helps prevent the hypotension that sometimes results following blood donations (3). NASA now uses the device to help maintain BP in astronauts who develop hypotension upon exposure to gravity after prolonged space flight (7,8). The ResQGARD is well-tolerated from the standpoint of work of breathing (11).

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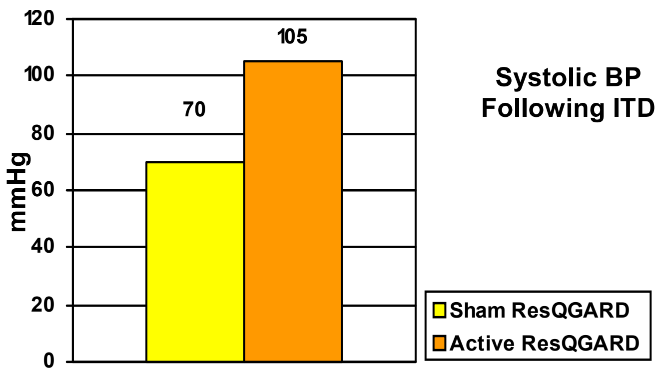
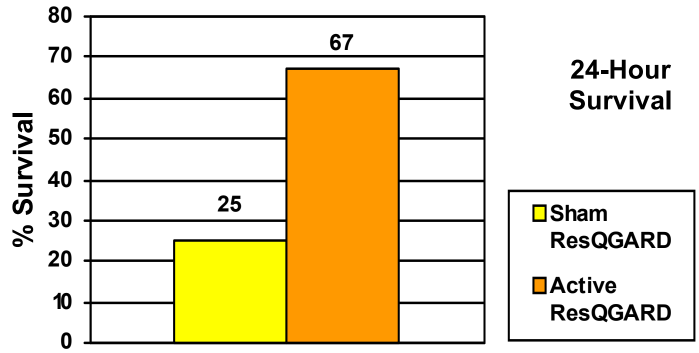
USE OF AN IMPEDANCE THRESHOLD DEVICE (E.G.RESQGARD™) FOR THE TREATMENT OF HYPOTENSION IN SPONTANEOUSLY BREATHING APPLICATIONS

ANIMAL STUDIIES: HYPOVOLEMIC SHOCK

Animal studies have shown that inspiration through an ITD increases blood pressure, cardiac output and survival rates after hypotension induced by severe blood loss. In one randomized, blinded study (15; Lurie et al. *Crit Care Med 2004*), pigs were bled to a target blood pressure (BP) of 50-55 mmHg, then were treated for 30 min. with either a sham (placebo) or active (functional) ITD. Animals treated with an active ITD had a 50% higher systolic BP than animals treated with a sham (p<0.01).



In another randomized, blinded study (21; Metzger et al. *Circulation 2007*), pigs were subjected to a 40% bleed and then randomized to receive either a sham or active ITD. Animals treated with an active ITD were 2.5 times more likely to survive to 24 hours compared to animals treated with a sham ITD (p=0.04).



In an animal model, the ITD also helps to maintain BP during heat shock (14,29). Animal studies further show that inspiration through an ITD lowers intracranial pressures in normotensive or hypotensive animals (12,14,15,17,27,30).

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The generally cleared indication for the ResQGARD is for a temporary increase in blood circulation during emergency care, hospital, clinic or home use. Studies are on-going in the United States to evaluate the benefit of the ResQGARD for indications related to patients experiencing hypotension during dialysis and severe blood loss. The studies listed here are not intended to imply specific outcome-based claims not yet cleared by the US Food and Drug Administration.