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AAJT-S

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SAFETY & EFFICACY 01

1.1 Use of the Abdominal Aortic Tourniquet to Reduce or Eliminate Flow in the Common Femoral Artery in Human Subjects.

Human testing confirmed the AAJT's effectiveness in significantly reducing or eliminating blood flow in the common femoral artery, supporting its application in temporary hemorrhage control.

1.2 Hemodynamic Effects of the Abdominal Aortic and Junctional Tourniquet in a Hemorrhagic Swine Model.

"AAJT application in an animal model of severe shock results in a favorable hemodynamic profile"

1.3 Temporary Compression of the Aorta in Combat Surgical Trauma.

"AAJT is an innovation for the management of bleeding from the inferior part of the torso that is not amenable to compression and cannot be stopped by standard tourniquets."

1.4 The Evaluation of an Abdominal Aortic Tourniquet for the Control of Pelvic and Lower Limb Hemorrhage.

This study shows the AAJT to be effective in the control of blood flow in the pelvis and proximal lower limb and potentially lifesaving.

TRAUMATIC CARDIAC ARREST 02

2.1 Successful Management of Battlefield Traumatic Cardiac Arrest Using the Abdominal Aortic and Junctional Tourniquet (AAJT), A Case Series

"Using the novel AAJT-S (along with the administration of whole blood & CPR) produced a 100% success rate in achieving ROSC"

2.2 The Use of the Abdominal Aortic and Junctional Tourniquet During Cardiopulmonary Resuscitation Following Traumatic Cardiac Arrest in Swine

"Animals with AAJT survived 83% (5/6) compared to 17% (1/6) of animals without AAJT."

REBOA EQUIVALENCY 03

3.1 Comparison of Zone 3 Resuscitative Endovascular Balloon Occlusion of the Aorta and the Abdominal Aortic and Junctional Tourniquet in a Model of Junctional Hemorrhage in Swine

"Despite their mechanistic differences, both techniques achieved a similar hemostatic, hemodynamic, and metabolic profile."

REBOA EQUIVALENCY CONTINUED

3.2 Increased Crystalloid Fluid Requirements During Zone 3 Resuscitative Endovascular Balloon Occlusion of the Aorta (REBOA) versus Abdominal Aortic and Junctional Tourniquet (AAJT) After Class II Hemorrhage in Swine

The use of the AAJT in Zone 3 required 7.2 times less crystalloids than REBOA.

NON-COMPRESSIBLE TORSO HEMORRAGE 04

4.1 Abdominal Aortic Junctional Tourniquets - Clinically Important Increases in Pressure in Aortic Zone 1 and Zone 3 in a Cadaveric Study Directly Relevant to Combat Medics Treating Non-compressible Torso Hemorrhage.

"The AAJT-S at 250mmHg achieves proximal epigastric compartment pressures of 40mmHg. This represents a highly significant and titratable reduction in blood flow within the celiac trunk branches."

JUNCTIONAL HEMORRHAGE: AXILLA & INGUINAL 05

5.1 Abdominal Aortic Tourniquet Controls Junctional Hemorrhage From a Gunshot Wound of the Axilla

A case report demonstrated the successful use of the AAJT to control life-threatening junctional hemorrhage from a gunshot wound to the axilla, highlighting its versatility beyond lower torso bleeding.

5.2 Abdominal Aortic and Junctional Tourniquet Controls Hemorrhage From a Gunshot Wound of the Left Groin

This case report details the effective use of the AAJT to control severe hemorrhage from a gunshot wound to the left groin, demonstrating its application in managing junctional bleeding in the prehospital setting.

5.3 Efficacy of the Abdominal Aortic Tourniquet Device for the Control of Axillary and Femoral Artery Blood Flow.

The AAT was uniformly effective in stopping flow in the proximal femoral artery and the axillary artery

POSTPARTUM HEMORRHAGE 06

6.1 Temporary Aortic Occlusion with the Abdominal Tourniquet for Refractory Postpartum Hemorrhage: A Proof-of-Concept Study in a War-affected Region

"The abdominal aortic tourniquet was effective in temporarily controlling severe PPH in a conflict-affected, resource-limited setting."

SCAN

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1.1 *Lyon M, Shiver SA, Greenfield EM, et al.* Use of the Abdominal Aortic Tourniquet to Reduce or Eliminate Flow in the Common Femoral Artery in Human Subjects. *J Trauma Acute Care Surg. 2012;73(2 Suppl 1):S103-S105. doi:10.1097/TA.0b013e3182606219*

Study Design. This prospective observational study involved nine healthy male volunteers and assessed the ability of the Abdominal Aortic Tourniquet (AAT) on required occlusive pressures to occlude femoral artery blood flow as well as user discomfort. Application protocols and physiologic assessments used standardized methods, including Doppler ultrasound for blood flow evaluation and a 10-point verbal pain scale for discomfort assessment. The study population's demographic data was recorded, including age, height, weight, and waist circumference.

Methodology. The AAT was placed just above the iliac crests, and its bladder was inflated over the anterior abdomen. Pulse wave Doppler ultrasound was used to measure arterial phasicity and peak systolic blood flow in the common iliac artery. Measurements were performed at baseline and at every 30 mm Hg increment in bladder pressure as the device was inflated.

Device Application & Efficacy. Application in all participants took less than a minute and was performed by a single provider. Flow was consistently reduced in all subjects, with total cessation achieved in 7 of 9 participants at a median pressure of 180 mm Hg (range 150 – 230 mm Hg). The two instances of incomplete occlusion were thought to result from muscular resistance to abdominal compression. Discomfort at cessation of blood flow had a median score of 7 (range 3 – 10) on the pain scale but returned to zero after device removal.

Hemodynamic & Metabolic Outcomes. Data on systemic hemodynamics and metabolic parameters were not reported for these human participants.

Survival & Tissue Viability. There was no direct assessment of survival or tissue viability in participants, since the study used healthy volunteers undergoing temporary device application. No animal or human data from this study described long-term survival or histological tissue outcomes.

Adverse Events. No adverse events or injuries were reported.

Clinical & Comparative Relevance. Uncontrolled junctional hemorrhage remains a major cause of preventable deaths in combat trauma, and effective treatment options for proximal femoral and iliac vessel injuries are limited. The AAT offers a tactical advantage over hemostatic agents and other junctional tourniquets by providing bilateral iliac and femoral vessel control, possibly with greater versatility for higher proximal injuries.

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1.2 *Rall JM, Ross JD, Clemens MS, Cox JM, Buckley TA, Morrison JJ.* **Hemodynamic Effects of the Abdominal Aortic and Junctional Tourniquet in a Hemorrhagic Swine Model**. *J Surg Res. 2017;212:159-166. Doi:10.1016/j.jss.2017.01.020*

Study Design. The study employed a randomized controlled design for a 120 minute application using 40 male Yorkshire swine (70-90 kg) divided into four groups: hemorrhage with AAJT application (Hem/AAJT), hemorrhage without AAJT (Hem/no-AAJT), sham hemorrhage with AAJT (no-Hem/AAJT), and sham hemorrhage without AAJT (no-Hem/no-AAJT). A controlled hemorrhage of 40% estimated blood volume was induced over 45 minutes, followed by a 15-minute hypovolemic stabilization period before AAJT application. The intervention phase included two 500 mL Hextend boluses administered 30 minutes apart. Primary outcomes focused on cardiac output (CO) changes, while secondary outcomes included cardiovascular, pulmonary, and metabolic parameters and histologic assessments of lung and bowel tissues.

Physiologic Parameters. Key metrics included mean arterial pressure (MAP), systemic vascular resistance (SVR), cardiac output (CO), central venous pressure (CVP), mean pulmonary arterial pressure (MPAP), PaO2/FiO2 ratio, lactate levels, and base excess. Pulmonary and bowel histology were evaluated for necrosis, edema, and inflammation. Hemorrhaged groups exhibited significant reductions in MAP (23.5 ± 2.4 mmHg vs. 61.6 ± 7.8 mmHg in sham groups) and CO (2.18 ± 0.55 L vs. 5.70 ± 1.1 L at baseline), alongside elevated lactate levels (4.82 ± 2.1 mmol/L in Hem/AAJT).

Device Application & Efficacy. The AAJT was inflated to > 250 mmHg, achieving femoral artery occlusion confirmed by loss of pulse pressure. It reduced femoral blood flow significantly in both hemorrhaged and non-hemorrhaged groups ($P < 0.001$). Device placement did not alter CO compared to controls but increased MAP and SVR, indicating afterload support.

Hemodynamic & Metabolic Outcomes. AAJT application increased MAP and SVR without affecting CO or fluid resuscitation responsiveness. Lactate levels peaked similarly in hemorrhaged groups (4.82 ± 2.1 mmol/L in Hem/AAJT vs. 3.77 ± 1.5 mmol/L in Hem/no-AAJT), with no metabolic acidosis exacerbation. Central venous pressure (CVP) and pulmonary parameters (MPAP, PaO2/FiO2) showed no significant intergroup differences, suggesting no adverse cardiopulmonary effects.

Survival & Tissue Viability. All animals survived except one in the Hem/no-AAJT group, which succumbed post-fluid bolus. Histological analysis revealed no necrosis, edema, or inflammation in lung or bowel tissues across groups, confirming tissue viability.

Adverse Events. No adverse events directly attributable to AAJT were observed. Concerns about caval compression exacerbating hypotension were unsupported, as CVP and CO remained stable. The single death in the Hem/no-AAJT group was attributed to hemorrhagic shock.

Clinical & Comparative Relevance. The AAJT provided hemodynamic stabilization comparable to REBOA but with less invasiveness.

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1.3 *Lurin IA, Khoroshun EM, Panasenko SI, Makarov VV, Negoduiko VV, Shypilov SA, Kerbazh NR.* **Temporary Compression of the Aorta in Combat Surgical Trauma.** *World of Medicine and Biology. 2024;4(90):88-92. doi:10.26724/2079-8334-2024-4-90-88-92*

Study Design. This retrospective analysis examined 76 cases of temporary aortic occlusion (TPO) in Ukrainian combat trauma patients. Methods included use of the AAJT-S, resuscitative endovascular balloon occlusion of the aorta (REBOA), and atraumatic thoracic aortic clamping during open thoracotomy. Cases were assessed for success in bleeding control and survival during medical evacuation and resuscitation phases.

Physiologic Parameters. The cohort consisted entirely of male combat casualties with an average age of 42.3 ± 2.4 years. Occlusion techniques were applied in 67 patients (88.2%) during resuscitation and in 9 (11.8%) intraoperatively.

Device Application & Efficacy. The AAJT-S was used in 7 cases (9.2%) and achieved hemorrhage control in 4 of them (57.1%). This success rate was higher than with open thoracotomy and aortic clamping (54.2%) and REBOA, which was used in one case and failed to achieve bleeding control.

Hemodynamic & Metabolic Outcomes. Specific measurements were not reported. However, the AAJT-S was deemed effective for maintaining perfusion and control in austere and mobile settings such as rescue, dragging, and CASEVAC procedures.

Survival & Tissue Viability. Of the 7 patients treated with AAJT-S, 4 survived (57.1%). The study did not detail organ viability or ischemic complications associated with the device.
Adverse Events. The study referenced historical data suggesting faster aortic occlusion may increase complication severity. However, no direct AAJT-S complications were noted.

Clinical & Comparative Relevance. The AAJT-S was identified as a superior option for basic prehospital care and CASEVAC missions due to ease of use and tactical applicability. Authors concluded that AAJT, REBOA, and open clamping are complementary and serve as bridging interventions, not alternatives.

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1.4 *Taylor, David M., et al.* The Evaluation of an Abdominal Aortic Tourniquet for the Control of Pelvic and Lower Limb Hemorrhage *Military Medicine, vol. 178, no. 11, 2013, pp. 1196-1201.*

Study Design. This prospective observational study involved 16 healthy male volunteers under the age of 25 and assessed the ability of the Abdominal Aortic Tourniquet (AAT) to occlude common femoral artery (CFA) as well as user discomfort. The balloon was inflated until flow in the CFA ceased or the maximum pressure of the device was reached. Application protocols and physiologic assessments used standardized methods, including Doppler ultrasound for blood flow evaluation. Basic demographic data, height, weight, blood pressure, and abdominal girth were recorded.

Methodology. The AAT was placed over the umbilicus. Doppler measurements were taken of the CFA. Measurements were taken at baseline (before any inflation of the bladder) and then continuously, as the AAT bladder was inflated. The balloon was inflated until either blood flow ceased in the CFA or the maximum recommended pressure in the balloon was reached. The pressure at which femoral flow became biphasic and at which all flow ceased was recorded.

Device Application & Efficacy. In 94% participants (15/16), blood flow in both the CFA was stopped, as measured by no spectral Doppler flow. All flow in the CFA ceased in 15 of the 16 participants. The balloon was inflated for less than 1 minute in all cases and normal triphasic flow was restored in all participants immediately upon deflation of the balloon. No immediate complications were identified. The median and modal pressure at which flow occluded was less than 250 mm Hg. The mean phase change occurred at less than 150 mm Hg. In the single case in which the tourniquet failed to occlude flow, the maximum balloon pressure of 300 mm Hg was achieved without any phase change in the CFA identified on Doppler. The subject in whom the device failed to occlude flow was found to have a height, weight, BMI, and abdominal girth greater than the average in the study but a normal systolic blood pressure.

Survival & Tissue Viability. There was no direct assessment of survival or tissue viability in participants, since the study used healthy volunteers undergoing temporary device application. No animal or human data from this study described long-term survival or histological tissue outcomes.

Adverse Events. No adverse events or injuries were reported.

Clinical & Comparative Relevance. The study demonstrates that a simple deployable device that does no further harm and prevents blood flow below the bifurcation of the aorta works. The authors conclude, “This device could be of great potential benefit in present battlefield scenarios as well as those in future conflicts where surgical facilities may be more primitive and casualty evacuation times far greater. We also feel that such a device could be of benefit in exsanguination cardiac arrest, as well as civilian disaster relief events or terrorist incidents.”

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2.1 *Androshchuk D, Verba A.* Successful Management of Battlefield Traumatic Cardiac Arrest Using the Abdominal Aortic and Junctional Tourniquet (AAJT), A Case Series *J Spec Oper Med 2025 Apr 4;25(1):65-69. doi: 10.55460/7FEV-3ZRK.*

Study Design. The paper presents a retrospective case series analysis of six combat casualties experiencing traumatic cardiac arrest (TCA) secondary to hemorrhagic shock during the Russo-Ukrainian conflict. Conducted at Role 2a/b surgical stabilization sites in Bakhmut (2022) and Slovyansk (2023), the observational study evaluated the Abdominal Aortic and Junctional Tourniquet-Stabilized (AAJT-S) as an adjunct to cardiopulmonary resuscitation (CPR) and blood product administration. Approval was obtained from Ukrainian Medical Command, with data collection focused on resuscitation outcomes rather than controlled experimental parameters.

Physiologic Parameters. AAJT-S application increased MAP and coronary perfusion pressure by redirecting circulating blood volume to the heart, brain, and lungs during CPR1. While the study references improved carotid blood flow and end-tidal CO_2 levels from prior swine models, specific quantitative hemodynamic measurements (e.g., MAP changes, lactate clearance) were not reported for human subjects.

Device Application & Efficacy. Applied during TCA episodes lasting ≤3 minutes, the AAJT-S achieved 100% return of spontaneous circulation (ROSC) across all six cases when combined with CPR and lyophilized plasma/blood transfusions. Inflation durations ranged from 30–120 minutes, with no device failures reported. The device demonstrated superiority over the SAM Junctional Tourniquet in one case of pelvic hemorrhage. Combat medics applied the AAJT-S in ≤1 minute during transport or at Role 2 facilities, contrasting with REBOA's 7–9 minute placement time.

Hemodynamic & Metabolic Outcomes. Hemodynamic stabilization occurred within 2–5 minutes of AAJT-S inflation, eliminating postoperative vasopressor requirements in all survivors. The authors hypothesize that sequestering blood flow to the upper torso enhances CPR efficacy by prioritizing cerebral and coronary perfusion. However, arterial blood gas analysis or tissue oxygenation metrics were not provided. No data on acid-base balance or lactate levels were included.

Survival & Tissue Viability. Four patients (66.7%) survived to discharge, with three confirmed neurologically intact at a 12-month follow-up. One mortality occurred at 10 days due to multisystem organ failure from pancreatic/hepatic injuries, while another died during evacuation delays caused by artillery bombardment. The study omitted tissue viability assessments (e.g., limb ischemia, renal function) post-AAJT-S removal.

Adverse Events. No immediate complications (vascular injury, compartment syndrome) occurred with inflation periods <120 minutes. One patient required subsequent thoracotomy for pulmonary injuries unrelated to device use1. Long-term sequelae were not documented beyond the 12–18 month follow-up window.

Clinical & Comparative Relevance. The AAJT-S showed equivalence to Zone 3 REBOA in hemorrhage control, requiring 86% less placement time. It reduced procedural complexity and resource demands in austere environments compared to emergency thoracotomy. Swine studies cited 83% ROSC rates with AAJT-S versus 5% survival in traditional TCA management, aligning with this study's 100% ROSC outcomes.

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2.2 *Rall JM, Cox JM, Maddry JK.* **The Use of the Abdominal Aortic and Junctional Tourniquet During Cardiopulmonary Resuscitation Following Traumatic Cardiac Arrest in Swine** *Mil Med. 2017;182(9-10):e2001-e2005. doi:10.7205/MILMED-D-16-00409*

Study Design. The study employed a prospective, randomized, blinded experimental trial using 12 splenectomized Yorkshire swine (70-90 kg) subjected to controlled hemorrhage at 2 mL/kg/min until systolic blood pressure fell below 10 mmHg, simulating traumatic cardiac arrest (TCA). Animals were randomized into two groups: CPR with AAJT application or CPR alone (control). Mechanical chest compressions (100/min, 5 cm depth) and rapid whole-blood transfusion (2,500 mL at 500 mL/min) were initiated after 3 minutes of arrest. Survival, return of spontaneous circulation (ROSC), and hemodynamic parameters were analyzed over a 1-hour observation period.

Physiologic Parameters. Key metrics included systolic/diastolic blood pressure, carotid blood flow, mean pulmonary artery pressure (MPAP), end-tidal CO2 (EtCO2), lactate levels, and base excess. Near-infrared spectroscopy monitored pectoralis muscle oxygenation, though detailed tissue oxygenation results were not provided. Baseline physiologic values (weight, hemorrhage time, blood loss) showed no significant intergroup differences.

Device Application & Efficacy. The AAJT was applied 2 minutes post-arrest (3 minutes pre-CPR) and inflated per manufacturer guidelines. AAJT use significantly improved ROSC rates (83% survival in AAJT group vs. 17% control) and reduced time to ROSC (6.9 ± 1.6 vs 8.0 minutes). Hemodynamic parameters post-compression, including systolic blood pressure (146 ± 49 vs. 29 ± 36 mmHg) and carotid flow (557 ± 357 vs. 77 ± 169 mL/min), were markedly higher in the AAJT group.

Hemodynamic & Metabolic Outcomes: AAJT animals exhibited superior hemodynamics after 10 minutes of compressions: systolic pressure (P = 0.001), diastolic pressure (P = 0.048), mean arterial pressure (P = 0.045), carotid flow (P = 0.014), MPAP (P = 0.010), and EtCO2 (P = 0.030). Lactate levels and base excess showed no intergroup significance through trends that suggested milder metabolic derangement with AAJT.

Survival & Tissue Viability. Kaplan-Meier analysis confirmed prolonged survival in the AAJT group (P = 0.02), with 5/6 animals surviving the 1 hour versus 1/6 controls. All survivors achieved ROSC during initial compressions. Tissue viability data were limited to survival endpoints; muscle oxygenation metrics were not detailed.

Adverse Events. Three animals were excluded due to ventricular fibrillation during hemorrhage, though the paper does not attribute this to AAJT. No device-related complications (e.g., pulmonary compromise or proximal bleeding) were reported despite prior concerns cited in the literature.

Clinical & Comparative Relevance. The study positions AAJT as a potential adjunct for TCA resuscitation, contrasting with ineffective standard CPR in hypovolemia. Results align with earlier findings on abdominal counterpressure devices but exceed outcomes seen with military anti-shock trousers or binders. Although mechanisms remain unconfirmed, the AAJT's dual aortic/venous occlusion may enhance coronary perfusion during compressions.

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3.1 *Rall JM, Redman TT, Ross EM, Morrison JJ, Maddry JK* **Comparison of Zone 3 Resuscitative Endovascular Balloon Occlusion of the Aorta and the Abdominal Aortic and Junctional Tourniquet in a Model of Junctional Hemorrhage in Swine** *J Surg Res. 2018;226:31-39. doi:10.1016/j.jss.2017.12.039*

Study Design. The study employed a randomized, prospective trial using 70-90 kg Yorkshire swine subjected to uncontrolled femoral hemorrhage via arteriotomy. Animals were allocated to AAJT (n = 10) or REBOA (n = 10) interventions, with a 5-animal cohort for model development. Primary outcomes included survival and hemostasis, while secondary outcomes encompassed hemodynamic parameters (e.g., mean arterial pressure (MAP), cardiac output), metabolic markers (lactate, creatinine), and tissue viability assessments: the protocol involved hemorrhage induction, device application, Hextend resuscitation, and a 2-hour post-intervention observation period.

Physiologic Parameters. Physiological monitoring included carotid/femoral MAP, cardiac output, pulmonary artery pressure, and lactate levels. During intervention, the AAJT group exhibited higher carotid MAP (59.9 ± 16.1 vs. 44.6 ± 9.8 mmHg) and femoral MAP, attributed to venous compression effects. Lactate levels were elevated in the AAJT cohort (4.5 ± 2.0 vs. 3.2 ± 1.3 mg/dL), though clearance rates matched between groups. Hemoglobin concentrations remained higher in AAJT-treated subjects (P = 0.029), likely due to reduced venous return. No significant differences occurred in cytokines (IL-6, IL-10, TNF-α) or renal/hepatic markers post-intervention.

Device Application & Efficacy. REBOA application was faster (60 ± 13 vs. 96 ± 43 seconds; P = 0.022) due to pre-placed femoral sheaths, while AAJT required sequential buckling and inflation. Both devices achieved 100% initial hemostasis, though spontaneous hemostasis occurred earlier with the AAJT (25.6 vs 37.0 minutes). Post-treatment blood loss was comparable (7.9% vs. 8.1% EBV).

Hemodynamic & Metabolic Outcomes. AAJT generated superior proximal blood pressures but caused higher peak inspiratory pressures (P = 0.013), suggesting thoracic compression effects in ventilated subjects. Both groups experienced transient hypotension and hypoxia during device removal, with one REBOA subject succumbing to cardiovascular collapse post-deflation. Metabolic acidosis was resolved similarly across groups, though AAJT-associated lactate elevations suggested a localized ischemic burden.

Survival & Tissue Viability. All AAJT subjects survived the 3-hour protocol, compared to 90% for REBOA. Histopathological analysis of kidney, lung, jejunum, and muscle tissues revealed no device-specific damage. Serum myoglobin and creatine kinase levels increased post-intervention but showed no intergroup differences, indicating comparable rhabdomyolysis risk.

Adverse Events. In ventilated subjects, the AAJT group exhibited higher inspiratory pressures without clinical pulmonary sequelae. One REBOA-related death occurred during reperfusion. Transient hypoxemia (SpO2 < 80%) occurred in both cohorts during device removal.

Clinical & Comparative Relevance. AAJT requires minimal training, making it suitable for prehospital use, while REBOA demands endovascular expertise but offers flexibility for abdominal hemorrhage via zone 1 occlusion. Clinical data remain limited to case reports for AAJT versus growing REBOA evidence showing 3.7% morbidity rates.

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3.2 *Brannstrom A, Dahlquist A, Gustavsson J, Arborelius UP, Gunther M.* **Increased Crystalloid Fluid Requirements During Zone 3 Resuscitative Endovascular Balloon Occlusion of the Aorta (REBOA) versus Abdominal Aortic and Junctional Tourniquet (AAJT) After Class II Hemorrhage in Swine** *Eur J Trauma Emerg Surg. 2021. Doi:10.1007/s00068-020-01592-x*

Study Design. This study compared crystalloid fluid requirements between zone 3 REBOA and AAJT in a porcine model of class II hemorrhage. Twelve male pigs (54-65 kg) were randomized to either AAJT (n=6) or zone 3 REBOA (n=6) after a controlled 25% blood volume hemorrhage. The interventions were maintained for 240 minutes, followed by a 30-minute reperfusion phase.

Physiologic Parameters. The researchers monitored multiple physiologic parameters including mean arterial pressure (MAP), systolic blood pressure (SBP), hear rate (HR), cardiac output (CO), stroke volume (SV), systemic vascular resistance (SVR), hematocrit, lactate, pH, base excess, and core body temperature. The primary outcome was cumulative crystalloid fluid requirements to maintain MAP >60 mmHg.

Device Application & Efficacy. Both devices were successfully applied with application times under one minute. The AAJT was inflated to 300 mmHg while the REBOA balloon was positioned in the infra-renal aorta and inflated with 8 mL NaCl. Complete occlusion of aortic blood flow was verified by loss of pulse wave and blood flow in distal arterial catheters. Both interventions caused a MAP increase of more than 100%, with peak MAP occurring at 20 minutes in the AAJT group and 40 minutes in the REBOA group.

Hemodynamic & Metabolic Outcomes. The AAJT group required significantly less crystalloid fluid (mean 333 mL, range 0-1000 mL) than the REBOA group (mean 2412 mL, range 800-4871 mL) to maintain target MAP, representing a 7.2-fold difference. SVR was significantly higher in the AAJT group between T0 and T30. Heart rates increased more in the AAJT group, while stroke volume was considerably higher in the REBOA group. Hematocrit increased by 17% in the AAJT group but decreased by 27% in the REBOA group. Lactate levels were significantly higher in the AAJT animals between T150 and the end of the experiment. Core body temperature increased in AAJT animals while REBOA animals became hypothermic.

Survival & Tissue Viability. All animals survived the intervention and subsequent 30-minute reperfusion phase. The study did not directly assess tissue viability, though the authors noted that AAJT removal caused more severe ischemic effects, suggesting more significant tissue damage.
Adverse Events. Release of the AAJT required vasopressor support with norepinephrine infusion for a mean time of 9.6 minutes, while REBOA animals required no vasopressor support. The AAJT group showed more severe metabolic acidosis after device removal, indicating a more significant ischemic insult.

Clinical & Comparative Relevance. The findings suggest that AAJT may be preferable in situations with limited fluid resources, such as battlefield or austere environments, as it provides hemodynamic support with minimal fluid requirements. However, the more severe reperfusion effects with AAJT suggest that transition to zone 3 REBOA, when feasible, may be beneficial to avoid deteriorating ischemic effects. The authors note that REBOA may not be possible in battlefield conditions due to the technical challenges of arterial access, catheter insertion, and balloon positioning.

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4.1 *Smith T, Pallister I, Parker P.* **Abdominal Aortic Junctional Tourniquets - Clinically Important Increases in Pressure in Aortic Zone 1 and Zone 3 in a Cadaveric Study Directly Relevant to Combat Medics Treating Non-compressible Torso Hemorrhage.** *J Spec Oper Med 2025 Apr 30;24(4):17-22. doi: 10.55460/KWGY-MP81.*

Study Design. The study employed an un-embalmed cadaver model using four donors to evaluate intra-abdominal pressure (IAP) changes induced by the AAJT-S. A manometric system with intraperitoneal balloons measured proximal (epigastric) and distal (pelvic) compartment pressures. Baseline IAP was set to 8 cmH_2O, and the AAJT-S was inflated to 250 mmHg. A simulated intraperitoneal hemorrhage (500 mL water) was introduced to assess pressure dynamics under hemorrhage-like conditions. Cadaver demographics included BMIs of 16.7-22.9 kg/m^2, with three female and one male donor.

Physiologic Parameters. Proximal epigastric IAP reached a mean of 54.6 cmH_2O (40.2 mmHg) without simulated hemorrhage and 52.25 cmH_2O (38.4 mmHg) with 500 mL fluid. Distal pelvic IAP averaged 36 cmH_2O (26.5 mmHg) and 41 cmH_2O (30.2 mmHg) under the same conditions. Though clinically irrelevant in this cohort, BMI exhibited a statistically significant inverse relationship with epigastric pressure (P = 0.001-0.003*).

Device Application & Efficacy. The AAJT-S was applied abdominally, centered on the umbilicus, and inflated to 250 mmHg per manufacturer guidelines. Proximal pressures exceeded 40 mmHg in 5/8 tests, achieving hypothesized tamponade thresholds for celiac trunk hemorrhage. Efficacy persisted despite simulated hemorrhage, with no significant difference in IAP between fluid/no-fluid states (P = 0.36*). Prior studies note combat medics can apply the device in <60 seconds post-training.

Hemodynamic & Metabolic Outcomes. No direct hemodynamic or metabolic data (e.g., blood pressure, lactate) were collected in this cadaver study. However, cited animal models demonstrate that AAJT-S improves mean arterial pressure and survival in hemorrhagic shock. In related studies, elevated IAP (40 mmHg) correlates with 50-90% reductions in splanchnic arterial flow.

Survival & Tissue Viability. Survival outcomes were not assessed in cadavers. Animal studies indicate ≤60-minute AAJT-S application causes reversible ischemic injury, while >90-minute use risks necrosis. Despite transient metabolic derangements, thermos-reversible foam trials showed no histological organ damage after 24-28 days.

Adverse Events. No adverse events were observed in the cadavers. Prior human trials report transient discomfort but no visceral injury with short-term use. Animal models suggest intestinal reperfusion injury resolves within two weeks for 60-minute applications.

Clinical & Comparative Relevance. The AAJT-S provides non-invasive zone 1/3 aortic occlusion, contrasting with REBOA, which requires surgical expertise and correlates with increased mortality in recent trials. Compared to intra-abdominal foam or gas insufflation, the AAJT-S offers titratable pressure control without laparotomy. Its prehospital applicability for combat medics is emphasized.

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JUNCTIONAL HEMORRHAGE: AXILLA & INGUINAL

5.1 *Croushorn J, McLester J, Thomas G, McCord SR.* Abdominal Aortic Tourniquet Controls Junctional Hemorrhage From a Gunshot Wound of the Axilla *J Spec Oper Med. 2013 Fall;13(3):1-4. doi:10.55460/61DQ-2EIQ*

Study Design. This is a single-patient case report describing an off-label use of the Abdominal Aortic Tourniquet (AAJT) used to control upper extremity junctional hemorrhage resulting from a gunshot wound to the axilla. It reports the first documented human application of the AAJT for upper-arm junctional bleeding.

Physiologic Parameters. The patient sustained a gunshot wound causing junctional arterial bleeding in the axilla not amenable to standard limb tourniquets. Detailed vital signs and blood loss volume were not provided.

Device Application & Efficacy. The AAJT was applied in the axillary region and achieved rapid cessation of bleeding. The device functioned effectively in a non-standard anatomical region to control hemorrhage.

Hemodynamic & Metabolic Outcomes. Hemodynamic data were not described, but the immediate control of bleeding suggests effective temporization. The report highlights lifesaving intervention in a challenging wound context.

Survival & Tissue Viability. The patient survived following AAJT application without reported device-related complications, ischemia, or injury. Long-term follow-up details were not included.
Adverse Events. No adverse events attributable to AAJT deployment were reported in this case.

Clinical & Comparative Relevance. This case demonstrates the feasibility of AAJT use beyond the torso—specifically for upper extremity junctional hemorrhage in prehospital settings. It underscores AAJT's potential versatility in managing life-threatening bleeds not amenable to conventional tourniquets.

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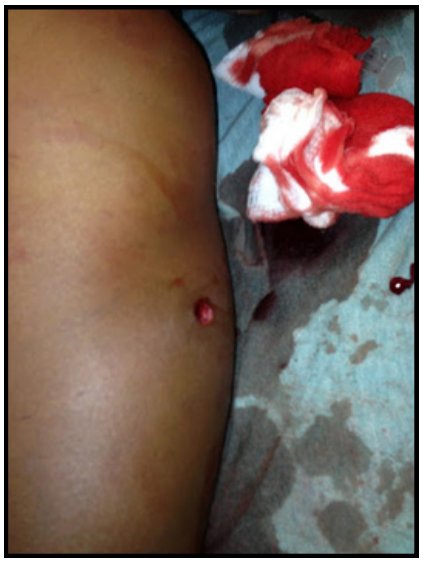

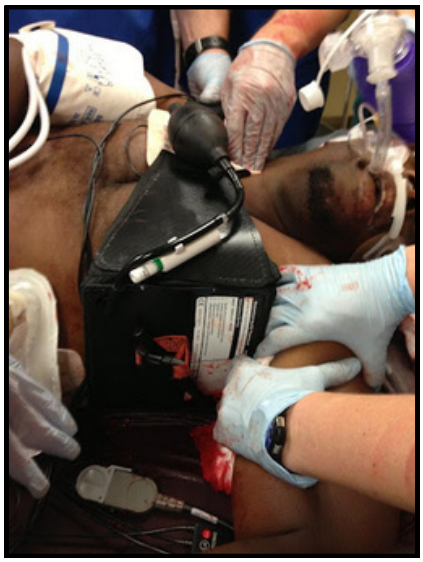

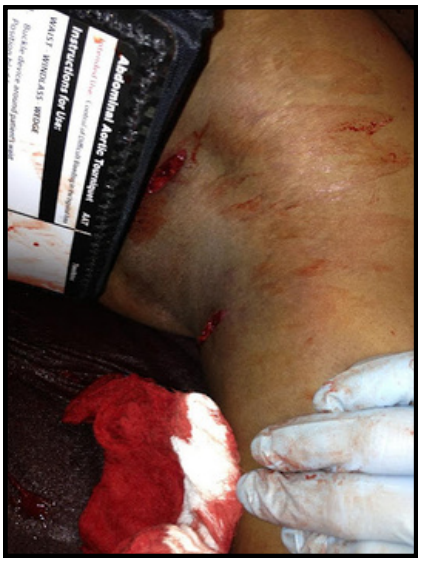

5.2 *Croushorn J.* Abdominal Aortic and Junctional Tourniquet Controls Hemorrhage From a Gunshot Wound of the Left Groin *J Spec Oper Med. 2014 Summer;14(2):6-8. doi: 10.55460/8IYL-YPCC*

Study Design. Single-patient case report detailing application of the FDA-cleared AAJT device to manage junctional hemorrhage in the left groin from a gunshot wound.

Physiologic Parameters. The 21-year-old male patient suffered three gunshot wounds to the lower extremities—with one entry/exit wound in the proximal left thigh causing massive hemorrhage. On arrival, he had tachycardia (~150 bpm), undetectable blood pressure, and a thready carotid pulse, consistent with hemorrhagic shock.

Device Application & Efficacy. A standard CAT tourniquet was initially applied to the proximal thigh. Due to anatomical constraints, a second CAT could not be positioned. The practitioner then applied the AAJT circumferentially over the hips at the groin level. Inflation to ~250–300 mmHg immediately stopped bleeding from the wound.

Hemodynamic & Metabolic Outcomes. Following AAJT deployment, bleeding ceased completely, and resuscitation progressed with blood transfusion. The patient's vitals stabilized enough to proceed with surgery.

Survival & Tissue Viability. The patient survived, required ligation of a transected deep femoral artery, and was ambulatory by postoperative Day 3. No device-related ischemic injury, thrombotic events, or long-term complications were reported.

Adverse Events. No complications were attributed to AAJT application. The device was well tolerated during use.

Clinical & Comparative Relevance. This case underscores the AAJT's value in controlling lower junctional hemorrhage in scenarios where standard tourniquets are not feasible, particularly in prehospital or austere environments. It demonstrates on-label use of AAJT and its versatility in life-threatening junctional injuries.

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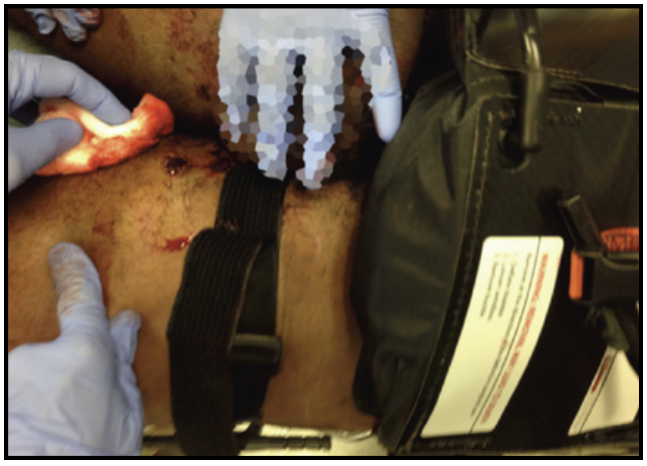

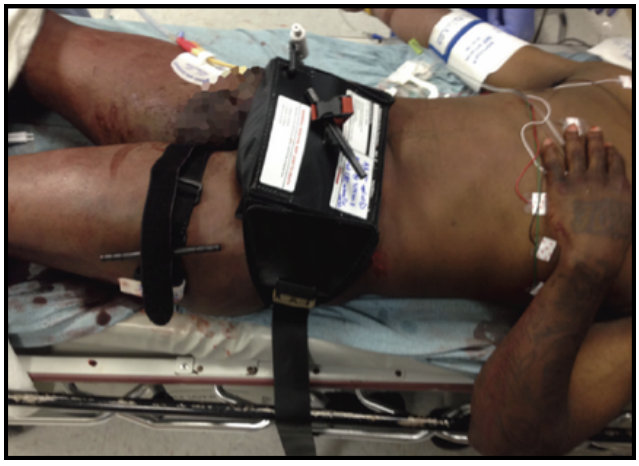

5.3 *Gordon, R.d., and M. Lyon.* Efficacy of the Abdominal Aortic Tourniquet Device for the Control of Axillary and Femoral Artery Blood Flow. *Annals of Emergency Medicine, vol. 64, no. 4, 2014.*

Study Design. This prospective observational study involved 13 healthy male volunteers and assessed the ability of the Abdominal Aortic Tourniquet (AAT) and required occlusive pressures to occlude both proximal femoral artery (PAF) and axillary artery (AA) blood flow as well as user discomfort. Application protocols and physiologic assessments used standardized methods, including spectral Doppler ultrasound for blood flow evaluation and a 10-point verbal pain scale for discomfort assessment. The study population's demographic data was recorded, including age, height, weight, and waist circumference.

Methodology. The AAT was placed over the anterior chest/axilla junction at the anterior axillary line for the AA measurements, with the strap placed across the contralateral shoulder. For the PFA, the AAT bladder was placed over the right groin with the strap positioned across both femoral trochanters. Spectral Doppler measurements were taken of the PFA and AA using a Phillips HDI 40000 ultrasound system. Measurements were taken at baseline (before any inflation of the bladder) and then continuously, as the AAT bladder was inflated. One investigator performed all measurements, maintaining the same Doppler angle and arterial location throughout each trial. Collected data included pressure of the AAT bladder at baseline, when the arterial tracing showed dampening from triphasic to monophasic flow, and at cessation of flow. A 10-point verbal pain scale also was used at each of these points.

Device Application & Efficacy. In all participants (13/13), blood flow in both the PFA and the AA were stopped, as measured by no spectral Doppler flow. For the PFA, mean bladder pressure at zero Doppler flow was 148.5 mm Hg (SD¼r44.8; maximum¼230, minimum¼80). For the AA, mean bladder pressure at zero Doppler flow was 168 mm Hg (SD¼52.5; maximum¼250, minimum¼80). Pain at maximum bladder pressure averaged 3.6 and 4.1 coinciding with flow cessation for the PFA and AA respectively and returned to 0 after AAT removal.

Survival & Tissue Viability. There was no direct assessment of survival or tissue viability in participants, since the study used healthy volunteers undergoing temporary device application. No animal or human data from this study described long-term survival or histological tissue outcomes.

Adverse Events. No adverse events or injuries were reported.

Clinical & Comparative Relevance. Penetrating injuries of the proximal large arteries (axillary, subclavian, illiac and femoral arteries) are a common cause of death on the
battlefield due to rapid exsanguination. Prior studies have shown that the abdominal aortic tourniquet (AAT) effectively reduced blood ow in the Common Femoral Artery with application of the device around the lower abdomen. This study specifically investigates the use at the junctional sites of the inguinal region and axillary region. The AAT was uniformly effective in stopping flow in the proximal femoral artery and the axillary artery after application of the AAT across the inguinal region of the lower pelvis and axillary region across the proximal chest.

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6.1 *Poliakova Y, Oshovskyy V.* Temporary Aortic Occlusion with the Abdominal Tourniquet for Refractory Postpartum Hemorrhage: A Proof-of-Concept Study in a War-affected Region *Int J Gynaecol Obstet. 2025 Jul 18. doi:10.1002/ijgo.70395*

Study Design. This case series evaluated the use of the AAJT-S in four adult women with primary postpartum hemorrhage (PPH) unresponsive to standard interventions. Conducted in war-affected Zaporizhzhia, Ukraine, this study assessed feasibility, efficacy, and safety of AAJT-S deployment as a temporizing measure.

Physiologic Parameters. All patients had PPH exceeding 1,000 mL due to uterine atony unresponsive to uterotonics and balloon tamponade. Baseline vitals were not reported in detail.

Device Application & Efficacy. The AAJT-S was applied to the upper abdomen and inflated to 250 mmHg. External bleeding was controlled within 2 minutes in all cases. Duration of inflation ranged from 30 to 45 minutes (mean: 38.8 minutes).

Hemodynamic & Metabolic Outcomes. While the study did not include continuous hemodynamic monitoring or lab data, 100% initial hemodynamic stabilization was achieved following AAJT-S application. Bleeding was controlled within two minutes in all four patients, and no active hemorrhage occurred during the 30–45 minute application period. This window enabled critical next steps, including anesthesia, blood product preparation, and surgical team mobilization. After deflation, three patients required surgery; one had spontaneous resolution of bleeding.

Survival & Tissue Viability. All four women survived without complications directly related to AAJT-S application. No evidence of thrombotic events, ischemia, or abdominal injury was observed during hospitalization.

Adverse Events. No device-related adverse events were reported. The study noted that AAJT-S tolerated deployment well in obstetric patients with no observed complications.

Clinical & Comparative Relevance. The AAJT-S offers a novel, non-invasive option for refractory PPH where surgical or interventional radiology resources are delayed or unavailable—especially relevant in conflict zones and austere environments.

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