



**SEM MAC**

State Emergency Medical  
Advisory Committee

Advisory No. 97-04

Title **Medical Anti-Shock Trousers**

Date Approved **August 7, 1997**

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New York State  
Department of Health

**Note:**

**This advisory guideline announces important changes in the *Statewide Basic Life Support Adult and Pediatric Treatment Protocols*. Revised copies of each of the protocols affected by these changes are attached. Revised copies of each of the protocols affected by these changes are also being sent to all emergency medical services agencies statewide.**

**Regional Emergency Medical Advisory Committees, and regional, system, and service medical directors are directed to facilitate use of the revised protocols at the local level, and are further advised to modify local protocols, policies, and procedures accordingly.**

**Medical Anti-Shock Trousers**

Current *Statewide Basic Life Support Adult and Pediatric Treatment Protocols* stipulate that Medical Anti-Shock Trousers (MAST), also known as the Pneumatic Anti-Shock Garment (PASG), should be inflated if the systolic blood pressure is below 90 mm Hg in adults or below 70 mm Hg in children and signs of inadequate perfusion are present, if MAST (PASG) are available. The State Emergency Medical Advisory Committee has reviewed these protocols, and concludes, on the basis of recent scientific evidence, that prehospital MAST (PASG) use in New York State should be considered only in adult major blunt trauma with severe hypotension (systolic blood pressure < 50 mm Hg) and hypotension (systolic blood pressure < 90 mm Hg) associated with unstable pelvic fracture.

In 1989, Mattox et al, in a prospective randomized study of 911 adult trauma patients, mostly with penetrating injuries, found that MAST (PASG) use was associated with longer scene times, and worsened the survival of adult patients with systolic hypotension (BP < 90 mm Hg) as well as those with primary thoracic injuries who presented in traumatic cardiac arrest. In 1992, Cooper et al, in a retrospective study of the efficacy of MAST (PASG) use in 436 pediatric trauma patients, mostly with blunt injuries, from the National Pediatric Trauma Registry who presented in hypotensive shock, found similar results. In 1993, Cayten et al reported the results of a retrospective study of MAST (PASG) use in 629 hypotensive adult trauma patients which concurred with Mattox's findings, although they were able to demonstrate a small but statistically significant survival advantage in severe hypotension (BP < 50 mm Hg). While there have been no prospective studies and no published trauma registry data in support of MAST (PASG) use for hypotension associated with unstable pelvic fractures, retrospective reviews and cases reports consistently support MAST (PASG) use in such circumstances.

In 1997, O'Connor et al performed a collective review of the scientific literature as an evaluation of MAST (PASG) in various clinical settings. On the basis of this review, Domeier et al developed a position paper on use of MAST (PASG) for the National Association of EMS Physicians, the Summary Recommendations from which, as they pertain to trauma, are summarized below.

MAST (PASG) are “usually indicated, useful, and effective” (Class I evidence) for:

- None.

MAST (PASG) are “acceptable, of uncertain efficacy, [although the] weight of evidence favors usefulness and efficacy” (Class IIa evidence) for:

- “Hypotension due to suspected pelvic fracture;
- Severe traumatic hypotension (palpable pulse, blood pressure not obtainable). \*\*”

MAST (PASG) are “acceptable, of uncertain efficacy, may be helpful, probably not harmful” (Class IIb evidence) for:

- “Penetrating abdominal injury;
- Lower extremity hemorrhage (otherwise uncontrolled); \*
- Pelvic fracture without hypotension; \*
- Spinal shock. \*\*”

MAST (PASG) are “inappropriate, not indicated, may be harmful” (Class III evidence) for:

- “Adjunct to CPR;
- Diaphragmatic rupture;
- Penetrating thoracic injury;
- Pulmonary edema;
- To splint fractures of the lower extremities;
- Extremity trauma;
- Abdominal evisceration;
- Acute myocardial infarction;
- Cardiac tamponade;
- Cardiogenic shock;
- Gravid uterus.”

\* Data from controlled trials not available. Recommendation based on other evidence.

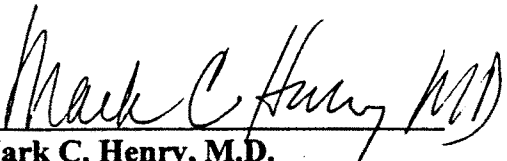
The literature cited supports the conclusion that the role of MAST (PASG) in the prehospital emergency medical care of adult and pediatric patients is extremely limited. The State Emergency Medical Advisory committee agrees with the National Association of EMS Physicians that the weight of the evidence favors the usefulness and efficacy of MAST (PASG) only for adult major blunt trauma with severe hypotension (systolic blood pressure < 50 mm Hg) and hypotension (systolic blood pressure < 90 mm Hg) associated with unstable pelvic fracture, a position which is consistent with the 1997 Edition of the Advanced Trauma Life Support Course of the American College of Surgeons.

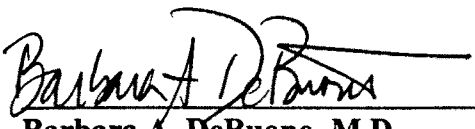
The State Emergency Medical Advisory Committee (SEMAC) therefore recommends their use under these circumstances, although Regional Emergency Medical Advisory Committees (REMAC) may prescribe their use under other circumstances to address specific local conditions.

The *Statewide Basic Life Support Adult and Pediatric Treatment Protocols* are being modified to reflect this change, and Regional Emergency Medical Advisory Committees, and regional, system, and service medical directors are advised to modify local protocols, policies, and procedures accordingly.

#### Selected References

1. Mattox KL, Bickell W, Pepe PE, et al: Prospective MAST study in 911 patients. J Trauma 1989;29:1104-1112.
2. Cooper A, Barlow B, DiScala C, et al: Efficacy of MAST use in children who present in hypotensive shock. J Trauma 1992;33:151.
3. Cayten CG, Berendt BM, Byrne DW, et al: A study of pneumatic antishock garments in severely hypotensive trauma patients. J Trauma 1993;34:728-735.
4. Flint L, Babikian G, Anders M, et al: Definitive control of hemorrhage from severe pelvic fracture. Ann Surg 1990;221:703-707.
5. O'Connor RE, Domeier RM: Collective review: An evaluation of the pneumatic anti-shock garment (PASG) in various clinical settings. Prehosp Emerg Care 1997;1:36-44.
6. Domeier RM, O'Connor RE, Delbridge TR, et al: Position paper: National Association of EMS Physicians: Use of the pneumatic anti-shock garment (PASG). Prehosp Emerg Care 1997;1:32-35.

  
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## Fractures/Dislocations

- I. Assure that the patient's airway is open and that breathing and circulation are adequate.
- II. Expose the injured area to locate and identify suspected fractures/dislocations.

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**Note:**

**Consider any wound near a fracture site to be the result of bone protrusion from an open fracture!**

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- III. Control bleeding as appropriate.
- IV. Assess for shock. **If shock is present, refer immediately to the Shock Protocol!**
- V. Evaluate and record the pulse(s), sensory and motor functions distal to the suspected fracture/dislocation site before splinting.
- VI. Splint the fracture/dislocation, keeping the following guidelines in mind:
  - A. An open fracture should be covered with a dry sterile dressing and any bleeding controlled.
  - B. An injured joint should be immobilized in the position in which it was found.
  - C. A severely angulated extremity fracture should be straightened by applying gentle traction to it. If resistance is encountered, the extremity should be splinted in the angulated position.
  - D. A femur fracture should be splinted with a traction splint.
  - E. If the patient is hypotensive, an unstable pelvic fracture should be splinted with the MAST (if available and regionally approved<sup>1</sup>) according to the **Shock Protocol**.
- VII. Transport the patient in a position of comfort, keeping the patient warm.
- VIII. Obtain and record the patient's vital signs, including the status of the distal pulse(s), repeat en route as often as the situation indicates.
- IX. Record all patient care information, including the patient's medical history and all treatment provided, on a Prehospital Care Report.

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<sup>1</sup> "Regionally approved" means approved by the appropriate regional emergency medical advisory committee (REMAC) for use in that region.

## Adult Major Trauma - Continued

### III. Assess the patient's circulatory status.

#### A If the pulse is absent (Traumatic Cardiac Arrest):

1. Extricate the patient rapidly.
2. Initiate transportation **immediately**. (Refer to item IV below.)
3. Perform CPR according to AHA/ARC standards.
4. Take appropriate steps to control hemorrhage.
5. Apply and inflate MAST, if available and regionally approved<sup>1</sup>, or elevate the foot of the backboard 30 degrees if MAST not available or not regionally approved<sup>1</sup>.
6. Record all patient care information, including all treatment provided, on a Prehospital Care Report (PCR).

#### B If the pulse is present:

1. Take appropriate steps to control hemorrhage.
2. Extricate the patient rapidly.
3. Initiate transportation **immediately**. (Refer to item IV below.)
4. Apply and inflate MAST, if available and regionally approved<sup>1</sup>, in adults with severe hypotension, or hypotension with unstable pelvic fracture, according to **the Shock Protocol**, or elevate the foot of the backboard 30 degrees if MAST not available or not regionally approved<sup>1</sup>.
5. Keep the patient warm en route.
6. Obtain and record the patient's initial vital signs, including capillary refill, repeat en route as often as the situation indicates.
7. Record all patient care information, including all treatment provided, on a Prehospital Care Report.

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1 "Regionally approved" means approved by the appropriate regional emergency medical advisory committee (REMAC) for use in that region.

**Pediatric Major Trauma - Continued**

III. Assess the child's circulatory status by palpating the brachial pulse in infants and the carotid pulse in children older than one year of age.

**A. If the pulse is absent (Traumatic Cardiac Arrest):**

1. Initiate transport **immediately** while performing CPR according to AHA/ARC standards.

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**Note:**

**Do not use the Automated External Defibrillator (AED) in Pediatric Cardiac Arrest!**

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2. Take appropriate steps to control hemorrhage.
3. Elevate the foot of the backboard 30 degrees.

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**Note:**

**Do not use MAST in Pediatric Major Trauma!**

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4. Record all patient care information, including the patient's medical history and all treatment provided, on a Prehospital Care Report.

**B. If the pulse is present:**

1. Identify any life-threatening hemorrhage, if present go to step C.
2. Initiate transport **immediately** while assessing the circulatory status.
3. Elevate the foot of the backboard 30 degrees.

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**Note:**

**Do not use MAST in Pediatric Major Trauma!**

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4. Keep the child warm en route.

## Pediatric Major Trauma - Continued

5. Obtain and record the patient's initial vital signs, including capillary refill, repeat en route as often as the situation indicates.
6. Record all patient care information, including the patient's medical history and all treatment provided, on a Prehospital Care Report.

### **C. If life-threatening hemorrhage is present:**

1. Initiate transport **immediately** while taking appropriate steps to control hemorrhage.

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**Caution:**

**Relatively small amounts of blood loss may be life-threatening in small children!**

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2. Assess for shock en route, **if clinical picture of shock is present (tachycardia, capillary refill greater than 2 seconds, cold clammy skin, thirst, restlessness and/or hypotension):**
  - a. Elevate the foot of the backboard 30 degrees.

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**Note:**

**Do not use MAST  
in Pediatric Major Trauma!**

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- b. Keep the child warm en route.
3. Obtain and record the patient's initial vital signs, including capillary refill, repeat en route as often as the situation indicates.
4. Record all patient care information, including all treatment provided, on a Prehospital Care Report.

### **IV. Transport to the appropriate hospital.**

1. Transport the patient to the nearest designated **Regional or Area Trauma Center designated to receive pediatric patients** if the total time elapsed between the estimated time of injury and the estimated time of arrival at the Trauma Center is less than one hour (see Appendices for a list of the New York State Designated Trauma Centers designated to receive pediatric trauma patients); **or**

**Shock - Continued**

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**Caution:**

**Manually stabilize the head and cervical spine if trauma of the head and neck is suspected!**

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- I. Assure that the patient's airway is open and that breathing and circulation are adequate.
- II. Administer high concentration oxygen, and **be prepared to ventilate the patient!**
- III. Place the patient in a face-up position **and** elevate the patient's legs or the foot of the backboard 30 degrees.
- IV. Apply MAST, if available and regionally approved<sup>1</sup>:
  - A. In adults with major blunt trauma, **if the systolic blood pressure is below 50 mm Hg and signs of inadequate perfusion are present**, inflate all three compartments to the recommended pressure **or** until the pop-off valves of all three compartments pop open.
  - B. In adults with major blunt trauma, **if the systolic blood pressure is below 90 mm Hg and signs of inadequate perfusion and unstable pelvic fracture are present**, inflate all three compartments to the recommended pressure **or** until the pop-off valves of all three compartments pop open.

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**Note:**

**Do not delay patient transport to apply and inflate MAST!**

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**Caution:**

- If the patient has pulmonary edema, do not apply MAST!**
  - If the patient has a penetrating chest injury, do not apply MAST!**
  - If the patient has unilaterally decreased breath sounds, do not apply MAST!**
  - If the patient has an evisceration or an impaled object in the abdomen or legs, inflate only the MAST compartments not overlying the evisceration or impaled object!**
  - If the patient is known to be pregnant, inflate only the MAST's leg compartments!**
  - If the patient has a cardiac related problem, do not apply MAST!**
  - If the patient is a child, do not apply MAST!**
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<sup>1</sup> "Regionally approved" means approved by the appropriate regional emergency medical advisory committee (REMAC) for use in that region.

## Appendix - Pediatric

### Appropriate Ventilatory Rates for Assisted Ventilation

| <u>Age Group</u>         | <u>If Respiratory Rate Is:</u> | <u>Ventilate At:</u> |
|--------------------------|--------------------------------|----------------------|
| Infant (< 1 yr)          | < 30/min                       | 20/min               |
| Toddler (1 - 2 yr)       | < 25/min                       | 20/min               |
| Preschooler (3 - 5 yr)   | < 20/min                       | 20/min               |
| School Age (6 - 12 yr)   | < 15/min                       | 20/min               |
| Adolescent (13 - 18 yr)* | < 10/min                       | 12/min               |

### Appropriate Ventilatory Rates for Hyperventilation in Severe Head Injury with Coma and Seizures or Herniation

| <u>Age Group</u>         | <u>Hyperventilate At:</u> |   |
|--------------------------|---------------------------|---|
| Infant (< 1 yr)          | 25/min                    | ➤ |
| Toddler (1 - 2 yr)       | 25/min                    |   |
| Preschooler (3 - 5 yr)   | 25/min                    |   |
| School Age (6 - 12 yr)   | 25/min                    |   |
| Adolescent (13 - 18 yr)* | 20/min                    |   |

**Hyperventilate only if GCS < 8 and one or more are present:**

- Active seizures
- Asymmetric pupils
- Cushing's reflex
- Periodic breathing
- Neurologic posturing
- Neurologic deterioration

### Criteria for Tachypnea (Rapid Respiratory Rate)

| <u>Age Group</u>         | <u>Respiratory Rate:</u> |   |
|--------------------------|--------------------------|---|
| Infant (< 1 yr)          | > 60/min                 | ➤ |
| Toddler (1 - 2 yr)       | > 40/min                 |   |
| Preschooler (3 - 5 yr)   | > 35/min                 |   |
| School Age (6 - 12 yr)   | > 30/min                 |   |
| Adolescent (13 - 18 yr)* | > 30/min                 |   |

**Use this formula to estimate the upper limit of respiratory rate in pediatric patients 1 - 10 yr**

**40 - (2x age)**

### Criteria for Tachycardia (Rapid Heart Rate)

| <u>Age Group</u>         | <u>Heart Rate:</u> |   |
|--------------------------|--------------------|---|
| Infant (< 1 yr)          | > 160/min          | ➤ |
| Toddler (1 - 2 yr)       | > 150/min          |   |
| Preschooler (3 - 5 yr)   | > 140/min          |   |
| School Age (6 - 12 yr)   | > 120/min          |   |
| Adolescent (13 - 18 yr)* | > 100/min          |   |

**Use this formula to estimate the upper limit of heart rate in pediatric patients 1 - 10 yr**

**150 - (5x age)**

### Criteria for Hypotension (Low Blood Pressure)

| <u>Age Group</u>         | <u>Blood Pressure:</u> |   |
|--------------------------|------------------------|---|
| Infant (< 1 yr)          | < 60 mm Hg             | ➤ |
| Toddler (1 - 2 yr)       | < 70 mm Hg             |   |
| Preschooler (3 - 5 yr)   | < 75 mm Hg             |   |
| School Age (6 - 12 yr)   | < 80 mm Hg             |   |
| Adolescent (13 - 18 yr)* | < 90 mm Hg             |   |

**Use this formula to estimate the lower limit of systolic blood pressure in pediatric patients 1 - 10 yr**

**70 + (2x age)**

\* Adult Value Used