

Brief Report: Systemic Vascular Access and Resuscitation via Corpus Cavernosum

Melville Bradley, MD, MSPH*†

ABSTRACT Background: Pre-hospital systemic vascular access with early resuscitation in the hypovolemic trauma patient can be problematic and is attempted through venous cut-downs, peripheral IV lines, and/or interosseous routes. This brief report examines an alternative for males via the corpus cavernosum (CC). Methods: A systematic literature review using certain inclusion criteria including, but not limited to, corpus cavernosum access and resuscitation was conducted and a summary table created. Findings: The six articles that met criteria revealed quick and easy CC access with rapid flow rates and resuscitation times in both humans and in animal models using either fluids or blood products. Only one article revealed a complication which was a shaft hematoma that resolved spontaneously over a period of a few days. Discussion/Impact/Recommendations: Systemic vascular access and resuscitation via the CC could be considered as a safe and effective alternative if more traditional techniques fail in an appropriate pre-hospital hypovolemic male casualty (i.e., no genital or pelvic trauma that could interfere with the technique). If further studies are conducted and the technique more robustly validated it could be considered as a possible addition to pre-hospital treatment protocols such as TCCC. Possible publication bias could have been a limitation of this study.

INTRODUCTION

Prehospital systemic circulation access is problematic in the volume-depleted patient. Currently, accepted field resuscitation access methods include venous cut-downs, peripheral lines, and osseous techniques (sternum, tibia). For male trauma victims, anecdotal evidence exists for the effectiveness of corpus cavernosum (CC) access with resuscitative success from the World War II era.¹ Two case series evaluating erectile dysfunction suggested the use of this method for resuscitation as well.^{2,3} Although no resuscitations were performed in these two studies, the authors of both noted ease of CC access without any complications. The technique described involved needle penetration mid-shaft in either of the corpora cavernosum with proper placement described as feeling a “click” when the tunica albuginea is penetrated; improper placement identified either by subcutaneous hematoma (tunica not penetrated) or infused fluid exiting the meatus (too deep with penetration into the urethra). The intent of this brief report is to summarize recent available literature with regard to CC access and resuscitation, and to draw conclusions that may be conducive to stimulate further research.

METHODS

A PubMed literature review from December 2015 was used to collect articles related to CC access and fluids/blood products’ resuscitation. Search terms used were as follows: “CC resuscitation,” “penile resuscitation,” “CC vascular access,” and “CC transfusion.” Articles with inclusion criteria of CC access and resuscitation were chosen for the review. A summary table was then created.

RESULTS

Six articles were found that met the inclusion criteria above. Results are summarized in Table I below. Five articles were interventional studies (four laboratory and one clinical) where canines, human males, and in one instance, donkeys were used as their own controls with regard to blood pressure measurements.^{4–8} Descriptive statistics were used to measure mean blood pressure changes before, during, and after resuscitation, mean fluid/blood products’ flow rates via the CC, and time necessary to establish systemic circulation access via the CC. The authors’ conclusions were similar across these five studies with regard to ease of CC access with no complications, minimal times to access, achievement of timely effective flow rates (independent of device used for access), and effective resuscitation as shown with postintervention increased blood pressures of clinical significance above shock pressures. The final article was a canine quasi-experimental study comparing flow rates between femoral line access and CC access; and with medication concentrations (phenobarbital was used) in blood as a function of infusion times.⁹ There were no statistically significant differences ($p > 0.05$) between CC flow rates and femoral line flow rates, as well as phenobarbital blood concentrations between the two techniques.

*Occupational Medicine Department, C.W. Bill Young VA Medical Center, 10000 Bay Pines Boulevard, Bay Pines, FL 33744.

†Department of Occupational and Environmental Health, College of Public Health, University of South Florida, Tampa, FL 33612.

This article is a U.S. Government work and, as such, is in the public domain of the United States of America. The stated views are those of the author and do not represent the views or policies of the Department of Veterans Affairs of the United States of America.

doi: 10.7205/MILMED-D-16-00001

TABLE I. Summary of CC Vascular Access Studies

Author	Population Description	No. of Completed Treatments	Study Description	Treatments	Control	p Values	Author Main Conclusions	Adverse Events Reported
Nicol et al ⁴	3 Male hypovolemic dogs	5	Laboratory interventional. 3 Hypovolemic dogs were resuscitated via CC using normal saline (NS), intravenous (IV) medications, colloid, and/or autologous whole blood.	Each dog: NS and IV medications. Dog 1 resuscitation with NS; dog 2 resuscitation with Haemaccel; dog 3 resuscitation with autologous whole blood (19-gauge butterfly needles).	IV access using same infusion pressures as CC access. Dogs served as own controls.	na	High CC infusion rates were adequate to resuscitate shocked dogs. Vasoactive medications were systemically effective when administered via CC.	None reported.
Gofrit et al ⁵	5 Male hypovolemic dogs and 10 male human patients	3	Laboratory interventional. 5 dogs resuscitated with Ringer's Lactate (RL) and autologous blood via CC. 10 humans infused with RL via CC. Pressure flow rates and time needed for intracorporeal needle insertions were recorded.	Each dog resuscitated with RL and autologous blood. Each human infused with RL. Mean infusion rate human: 89 mL/min. Mean infusion rate dog: 110 mL/min. Mean needle insertion time 15 seconds (19-gauge needles).	None	na; descriptive statistics only	An intracorporeal infusion line can be established in a short period of time and adequate quantities of fluids can be infused through human and canine corpora cavernosa.	None reported.
Abalos et al ⁶	3 donkeys and 3 dogs	12	Laboratory interventional. 3 male donkeys received 3 autologous whole blood transfusions each, and 3 male dogs received 1 autologous whole blood transfusion each; dogs were resuscitated successfully from shock.	Mean time for donkeys' blood collection was 12 minutes. Mean time to establish CC access was 22 seconds. Mean rate of transfusion was 31.7 mL/min. Dogs' mean transfusion rates 35.2 mL/min (19-gauge butterfly needles).	None	na; descriptive statistics only	The CC is a feasible, simple, rapid, and effective alternate route for blood transfusion and venous access.	None reported.

(continued)

TABLE I. Continued

Author	Population Description	No. of Completed Treatments	Study Description	Treatments	Control	p Values	Author Main Conclusions	Adverse Events Reported
Degim et al ⁹	10 dogs	10	Quasi-experimental. 5 dogs received CC IV with 26-gauge needle vs. control of 5 dogs that received femoral catheter. Dogs received phenobarbital (PB) in NS.	10 dogs of good health were divided into 2 groups of 5. Five received PB in NS via CC per 26-gauge needle with mean access time less than 5 seconds. Five received same treatment via femoral line. Both methods with similar flow rates and PB concentrations in blood post-treatments (26-gauge needles). 15 men received blood transfusions via their CC with no difficulties with needle access, transfusion flow rates, or with repetitive transfusions.	Five dogs receiving IV (via femoral line) PB in NS	$p > 0.05$ (no statistically significant differences in flows or PB concentrations in blood post treatments)	In the canine model, PB blood levels were comparable when solution was administered via IV or CC. There was faster access via CC than femoral line.	Follow-up period post-treatments was 48 hours. No localized or systemic complications were observed.
Shafik et al ⁷	15 human males	15	Clinical interventional. 7 men with massive burns, 6 with sclerotic veins, and 2 with extensive limb trauma were transfused with whole blood via CC.	15 men received blood transfusions via their CC with no difficulties with needle access, transfusion flow rates, or with repetitive transfusions.	None	na; descriptive statistics only	CC vascular access and use for transfusions is a simple, easy, rapid, and safe alternative in conditions where conventional routes are inaccessible.	2 penile hematomas which resolved spontaneously. No erection issues in 5 patients followed for a mean of 10.4 ± 1.8 months.
Stein et al ⁸	5 dogs	5	Laboratory interventional. Five hypovolemic dogs were resuscitated via CC with NS.	Five lab-induced hypovolemic dogs were resuscitated via CC with NS. Before bleed, mean systolic BP was 121.4 mm Hg. Mean shock systolic BP was 40.8 mm Hg. Mean systolic BP post-NS treatment was 114.6 mm Hg (after mean 15-minute treatment). Mean rate of NS infusion via CC was 50.2 mL/min (23-gauge butterfly needles).	None	na; Descriptive statistics only	The CC is a feasible route for IV fluid resuscitation in the shock canine model, and can be easily accessed with minimal training.	None reported.

na, not applicable.

Only one article reported a complication that involved a penile hematoma that resolved spontaneously.⁷

DISCUSSION

After reviewing the pertinent literature, another method for systemic circulation access via the CC in an appropriate casualty cohort (no genital or pelvic trauma that could interfere with the technique) could be an effective addition to the prehospital resuscitation toolbox for male trauma casualties if attempted venous or interosseous access fails. Further research to validate the procedure seems warranted. A possible limitation of this review is that it is not known whether publication bias may have had a role in the nonpublication of unfavorable results with CC access and resuscitation.

REFERENCES

1. Vedder JA: *Combat Surgeon: Up Front with the 37th Marines*. Chapter 10, p 147. Novato, CA, Presidio Press, 1998.
2. Godec CJ, Cass AS: The penis—a possible alternative emergency venous access for males? *Ann Emerg Med* 1982; 11(5): 266–8.
3. Pertek JP, Coissard A, Meistelman C, Cormier L, Hubert J: Intracavernous infusion: an alternative route to intravenous access during resuscitation? *Ann Emerg Med* 1998; 32(6): 753–4.
4. Nicol D, Watt A, Wood G, Wall D, Miller B: Corpus cavernosum as an alternative means of intravenous access in the emergency setting. *Aust N Z J Surg* 2000; 70: 511–4.
5. Gofrit ON, Leibovici D, Shapira SC, et al: Penile intracorporeal infusion—possible access to the systemic circulation. Pressure flow studies in dogs and humans. *Eur J Surg* 1997; 163(6): 457–61.
6. Abolyosr A, Sayed MA, Fathy E, Smeika MA, Shaker SE: Blood transfusion and resuscitation using penile corpora: an experimental study. *Urology* 2005; 66: 888–91.
7. Shafik A, El Sibai O, Shafik IA, Shafik AA: Corpora cavernosa as an alternative route for transfusion. *Front Biosci* 2006; 11: 2535–7.
8. Stein M, Gray R: Corpus cavernosum as an emergency vascular access in dogs. *Acad Radiol* 1995; 2: 1073–7.
9. Degim T, Dundaroz R, Sizlan A, Yasar M, Denli M, Gokcay E: The use of the corpus cavernosum for the administration of phenobarbital: an experimental study in dogs. *Int J Pharm* 2002; 246: 105–9.