

Michelle Trbovich, MD, Beth Wu, Dean Kellogg Jr., MD PhD  
The University of Texas Health Science Center at San Antonio  
South Texas Veterans Health Care System, San Antonio, TX

## Introduction

Persons with spinal cord injury (SCI) have compromised thermoregulatory vasomotor and sudomotor activity as a result of a decentralized sympathetic nervous system and impaired afferent temperature input to the hypothalamus. During heat stress, impaired cutaneous vasodilation diminishes skin blood flow (SkBF) and sweating responses (SR). (1,2) Thus SCI persons have difficulty maintaining thermal homeostasis, especially during heat stress. While multiple body cooling intervention trials have been performed in persons with SCI, these have all proven minimally successful, which is likely due to an incomplete understanding of the mechanistic changes in the peripheral autonomic nervous system post SCI. (3) In the non-SCI person, it is commonly thought that sympathetic cholinergic mechanisms mediate efferent control of both SkBF and SR through one and the same set of nerves; however, definitive proof is lacking. Indeed, cholinergic vasodilator nerves and cholinergic sudomotor nerves could actually be anatomically separate. (4-6)

Interestingly, in the 1970s, it was reported that during heat stress, persons with complete SCI have skin regions where SkBF increases without concomitant SR increases and other regions where SR increases without concomitant SkBF increases. (2) **These results suggest that efferent cholinergic sympathetic vasomotor nerves and efferent cholinergic sympathetic sudomotor nerves are separate.**

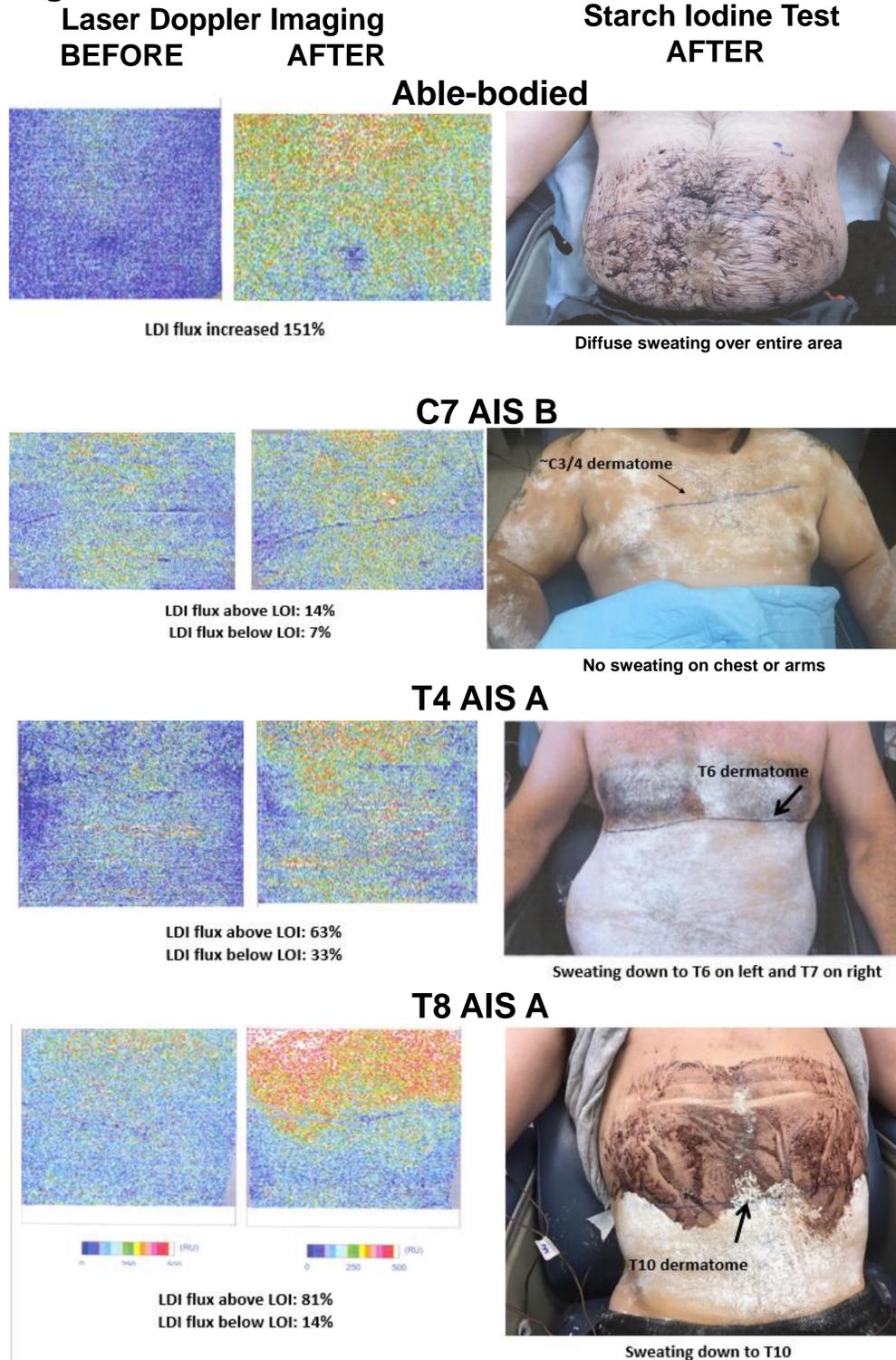
**We hypothesize that the areas of vasodilation and sweating will be discordant in persons with SCI and degree of discordance proportional to neurological level of injury (LOI).**

## Methods

- Four participants with varying LOI:
  - C7 AIS B
  - T4 AIS A
  - T8 AIS A
  - Able-bodied (AB)
- All underwent passive whole body heat stress via a water perfused heat suit and heating blankets until core temperature (measured orally) rose 1°C.
- Areas 5cm (or ~2-3 dermatomes) above and 10cm (or ~4-5 dermatomes) below LOI of persons with SCI were examined for
  - SkBF changes via laser doppler imaging (LDI) one day and
  - SR changes via starch iodine test another day
- Both tests were performed at the same time of day to negate the effects of circadian variation in core temperature.
- During evaluation of SkBF changes with LDI, area of interest was left uncovered by heating suit and blankets so as to avoid a local vasodilation effect from a skin axon reflex.

## Results

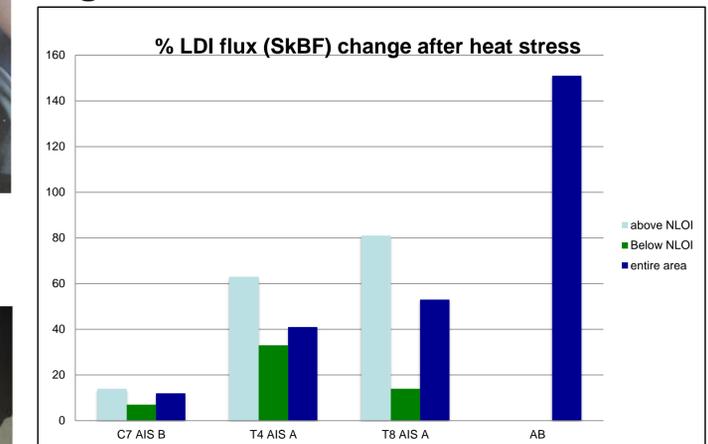
**Figure 1:**



**Figure 1 Legend:**

**Able-bodied:** +SkBF and +SR throughout the entire area examined (ie: T7-T12 dermatomes).  
**Tetraplegic:** (C7 AIS B): +SkBF but complete absence of SR  
**Paraplegics:** (T4 and T8 AIS A):  
**Above LOI:** +SkBF and +SR  
**Below LOI:** +SkBF was seen more caudal, +SR persisted down ~2-dermatomes caudal

**Figure 2:**



**Figure 2 Legend:**

SkBf in persons with SCI over the entire area of interest (dark blue bars) is significantly lower than that demonstrated in the AB. \*p=0.009.

SkBf below LOI (green bar) is significantly less in all 3 subjects compared to entire area (dark blue bars) \*p=0.04

SkBf below vs. above LOI approached significance (p=0.09)

Differences in SkBF changes between SCI subjects approached significance (p=0.07)

## Conclusions

- Discordant SkBF and SR responses are seen** in persons with tetraplegia and paraplegia during passive heat stress. These findings support the hypothesis that cholinergic sympathetic vasomotor nerves and cholinergic sympathetic sudomotor nerves may indeed be separate.
- The extent of discordant is **proportional to the level of spinal cord injury** with higher levels of injury exhibiting greater discordance than lower levels. All persons with SCI showed significantly less SkBF responses than AB.
- Persons with SCI can serve as a model to further investigate the neurological controls of SkBF and SR during heat stress.

This preliminary data is part of a larger study that will later utilize topical pharmacological agents to elucidate the neurological mechanisms underlying concordant (+SR and +SkBF) and discordant (-SR, +SkBF) areas, thereby providing rationale for therapy development.

## References

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**Funding:** VA Rehabilitation and Research Development, Career Development Award