

## 에타놀 섭취후 두부 상하위시 혈액학적 변화

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= Abstract =

**Hemodynamic Changes during Head-Down and Up Tilt  
after Ethanol Ingestion**

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**Background** : The acute effect, of ethanol(EOH) include lowered blood pressure through peripheral vasodilation and decreased circulating blood volume. This study was aimed at examining the effects of EOH on the hemodynamic response to up and down head tilts.

**Methods** : Ten 21 to 23 year old male adults served as subjects. Each subject participated in both control and EOH experiments. In the EOH experiment, 3 mls of 25% EOH per liter of total body water was administered orally, 35 min were allowed for the blood EOH level to reach maximum before the tilt protocol was initiated. The tilt protocol consisted of 5 stages, each stage was 3-min in duration : supine(0 °)-head down tilt(HDT, 15 °)-supine(0 °)-head up tilt(HUT, 25 °)-supine(0 °). Hemodynamic parameters were measured with an impedance cardiograph(NCCOM3-R7, BoMed) with two electrodes placed around the neck and two around the thorax. Blood pressure(BP) was measured with an automatic sphygmomanometer(DATEX). Data was collected during every second half-minute throughout the duration of the protocol.

**Results** : In the control, HDT produced an increase in the end-diastolic index(EDI), the stroke index(SI), the cardiac index(CI), and the peak flow index(PFI) ; there were no significant changes in heart rate(HR), the systemic vascular resistance index(SVRI), and BP. In contrast, HUT resulted in a decrease in EDI, SI, EF, CI, and PFI and an increase in HR, SVRI, and BP ; the latter changes sugges a sympathetic overactivation. In the EOH experiment, the basal EDI, SI, and systolic BP were lower and HR was higher than in control. HDT and HUT caused similar changes as in control experiments.

**Conclusion** : These results indicate that EOH causes volume depletion to result in reduced central blood volume and compensatory tachycardia. These EOH-induced changes were not altered by 15 ° head-down and 25 ° head-up tilts.

**KEY WORDS** : Alcohol · Gravity · Impedance cardiography.



결 과

(EDI) Fig. 1  
EDI  
94.5 ± 6.8ml/m<sup>2</sup> 108.2 ± 8.6  
ml/m<sup>2</sup> , 83.3 ± 5.4ml/m<sup>2</sup> 가,  
EDI 86.1 ± 6.7ml/m<sup>2</sup>

(SI) Fig. 2  
SI  
57.3 ± 4.4ml/m<sup>2</sup> 64.0 ± 5.1ml/m<sup>2</sup>  
가 46.8 ± 3.5ml/m<sup>2</sup>  
SI 51.5 ± 4.8ml/m<sup>2</sup>

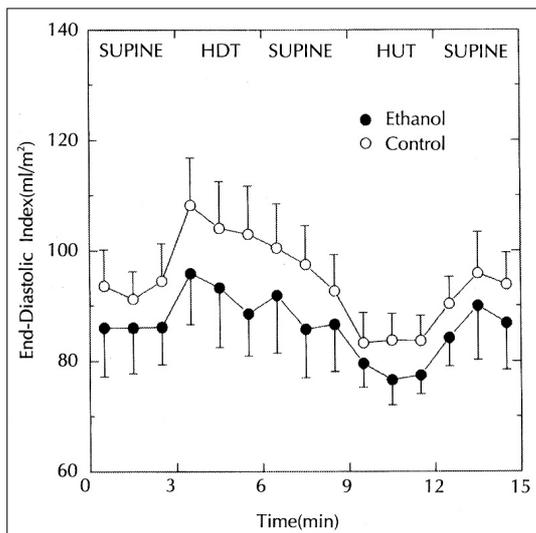


Fig. 1. End-diastolic index during head-down(HDT, 15 ) and head-up(HUT, 25 ) tilt protocol which started 35min after 25% ethanol ingestion(3ml/l of total body water). Vertical bars represent S.E.

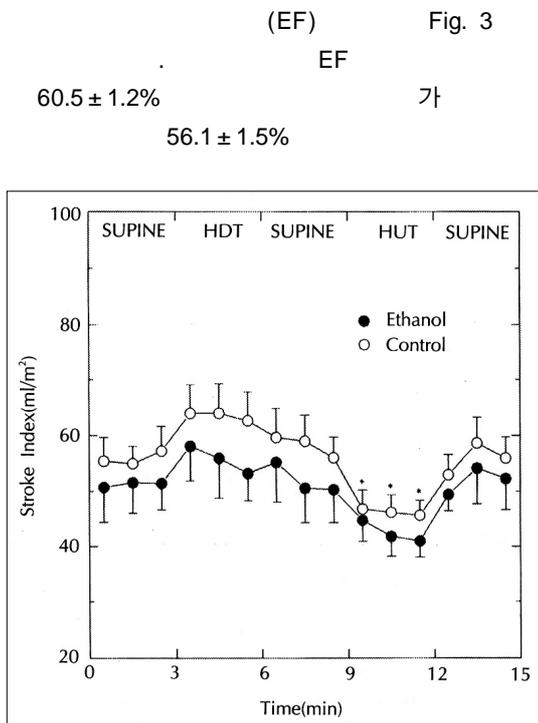


Fig. 2. Stroke index during head-down(HDT, 15 ) and head-up(HUT, 25 ) tilt protocol which started 35min after 25% ethanol ingestion(3ml/l of total body water). Vertical bars represent S.E. \*p<0.05, vs. HDT.

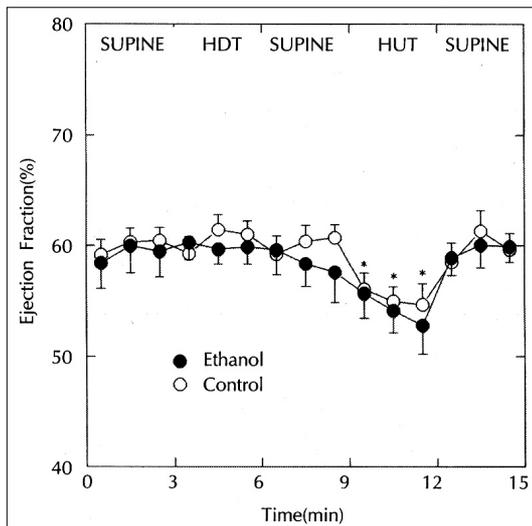


Fig. 3. Ejection fraction during head-down(HDT, 15 ) and head-up(HUT, 25 ) tilt protocol which started 35min after 25% ethanol ingestion(3ml/l of total body water). Vertical bars represent S.E. \*p<0.05, vs. initial supine position.

59.5 ± 2.3%

EF

3.88 ± 0.37 l · min<sup>-1</sup> · m<sup>-2</sup>

Fig. 4  
 ± 3.7beats/min 가  
 78.5 ± 3.2beats/min 가  
 76.6 ± 2.6beats/min  
 가가  
 84.1 ± 4.0beats/min  
 (CI) Fig. 5  
 CI  
 4.00 ± 0.38 l · min<sup>-1</sup> · m<sup>-2</sup> 4.59  
 ± 0.48 l · min<sup>-1</sup> · m<sup>-2</sup> , 3.44 ± 0.27 l ·  
 min<sup>-1</sup> · m<sup>-2</sup> 가,  
 CI

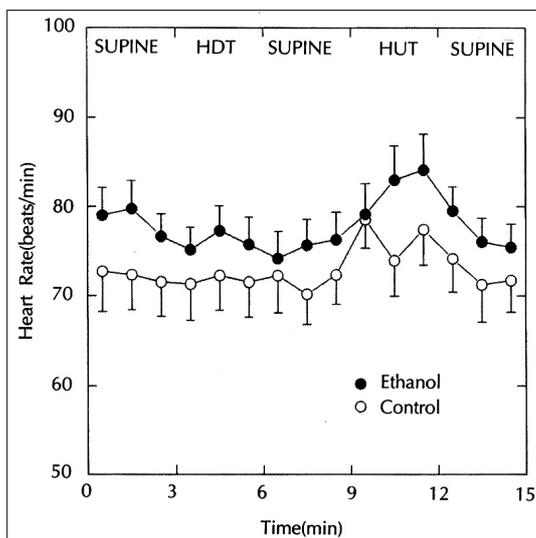


Fig. 4. Heart rate during head-down(HDT, 15 °) and head-up(HUT, 25 °) tilt protocol which started 35min after 25% ethanol ingestion(3ml/l of total body water). Vertical bars represent S.E.

(PFI) Fig. 6  
 PFI  
 395 ± 31 ml · s<sup>-1</sup> · m<sup>-2</sup> 441

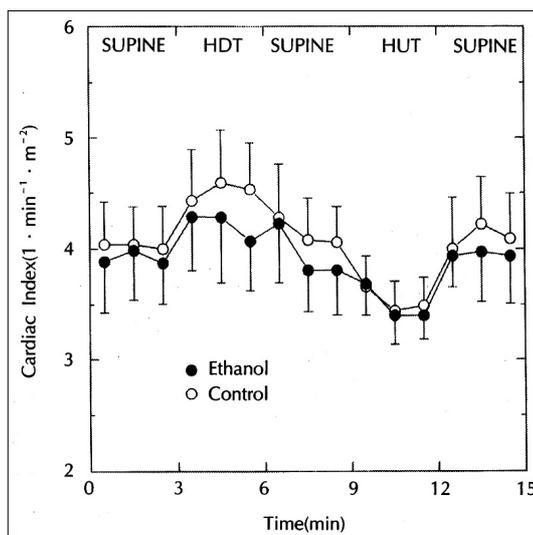


Fig. 5. Cardiac index during head-down(HDT, 15 °) and head-up(HUT, 25 °) tilt protocol which started 35min after 25% ethanol ingestion(3ml/l of total body water). Vertical bars represent S.E.

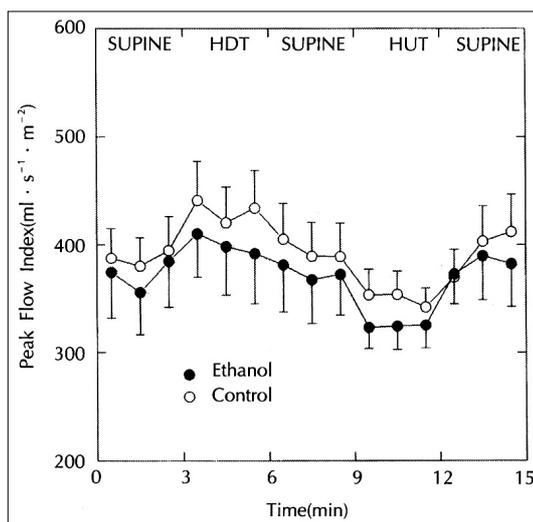


Fig. 6. Peak flow index during head-down(HDT, 15 °) and head-up(HUT, 25 °) tilt protocol which started 35min after 25% ethanol ingestion(3ml/l of total body water). Vertical bars represent S.E.

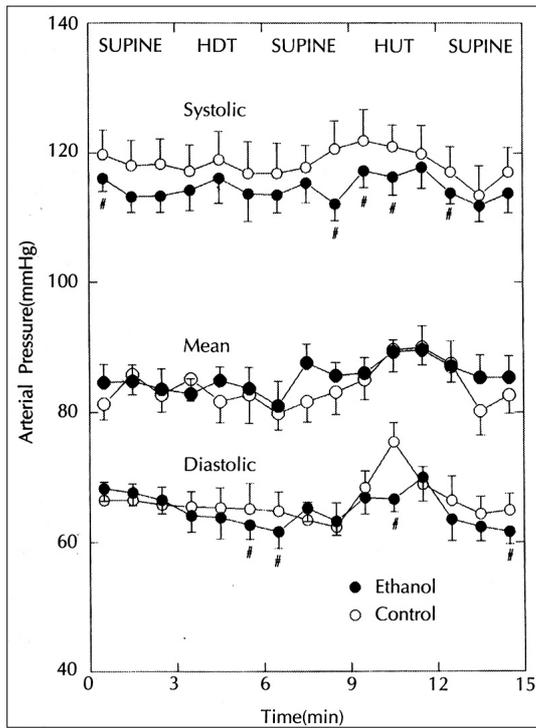


Fig. 7. Arterial pressure during head-down(HDT, 15°) and head-up(HUT, 25°) tilt protocol which started 35min after 25% ethanol ingestion(3ml/l of total body water). Vertical bars represent S.E. #p<0.05, vs. Control.

$\pm 36 \text{ ml} \cdot \text{s}^{-1} \cdot \text{m}^{-2}$ ,  $354 \pm 24 \text{ ml} \cdot \text{s}^{-1} \cdot \text{m}^{-2}$   
 $\text{m}^{-2}$  가,  
 PFI 385  
 $\pm 42 \text{ ml} \cdot \text{s}^{-1} \cdot \text{m}^{-2}$

(MAP) (SBP), (DBP)  
 Fig. 7  
 SBP 118.3 ± 3.9mmHg 가  
 121.9 ± 4.8mmHg 가  
 SBP 113.4 ± 2.5mmHg

SBP

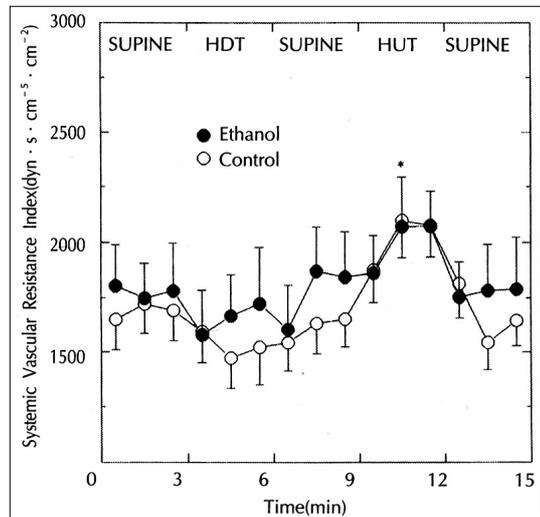


Fig. 8. Systemic vascular resistance index during head-down(HDT, 15°) and head-up(HUT, 25°) tilt protocol which started 35min after 25% ethanol ingestion(3ml/l of total body water). Vertical bars represent S.E. \*p<0.05, vs. initial supine position.

가  
 DBP 65.7 ± 2.7  
 mmHg 가  
 75.4 ± 2.9mmHg 가  
 DBP 66.4 ± 2.1mmHg  
 DBP가  
 MAP 가  
 가  
 가  
 (SVRI)

Fig. 8  
 SVRI 1,691 ± 139 dyn · s · cm⁻⁵ · m⁻² 가  
 2,099 ± 167 dyn · s · cm⁻⁵ · m⁻² 가  
 SVRI 1781 ± 216 dyn · s · cm⁻⁵ · m⁻²

고 안 EDI, SI, EF, CI PFI  
가 , SVRI 가  
가 , SVRI 가  
9,10)  
EDI, SI, CI PFI가 가  
EF, , SVRI EDI, SI, CI  
가 EDI, SI, CI PFI  
가 vasopressin 가 가 <sup>13)</sup>  
가 , EF, SVRI  
가 , 가  
2-4)  
EDI, SI, EF, CI 요 약  
PFI가 SI EF 연구배경 :  
가 SVRI 가 가 가  
, 가 (over -  
compensation) 가 ,  
EDI, SI, CI, PFI,  
SBP MAP가  
방 법 :  
21 23 10  
<sup>12)</sup> , 가 가 11  
가 SVRI 25% 3ml 가 35  
가 - (15 9) - - (25 9) -  
5 3  
2 impedance car -

diograph 1

결 과 :

가 EDI, SI, CI PFI가

가 EF, SVRI

가 EDI, SI,

가 EF, CI PFI가

가 SVRI 가

가 EDI, SI, CI, PFI, SBP MAP가

가 EDI, SI, EF, CI PFI가

가 SVRI 가

결 론 :

가

가

### References

- 1) Norsk P : *Gravitational stress and volume regulation. Clin Physiol* 12 : 505-526, 1992
- 2) Sagawa S, Miki K, Tajima F and Shiraki K : *Cardiovascular responses to upright tilt in man during acute exposure to 3 atm abs air. Undersea Biomed Res* 19 : 97-106, 1992
- 3) Taylor JA, Hand GA, Johnson DG and Seals DR : *Sympathoadrenal-circulatory regulation of arterial pressure during orthostatic stress in young and older men. Am J Physiol* 263 : R1147-R1155, 1992
- 4) Sagawa S, Shiraki K, Miki K and Tajima F : *Cardiovascular responses to upright tilt at a simulated altitude*

- of 3,700 m in men. *Aviation Space Environm Med* 64 : 219-223, 1993
- 5) Victor RG and Leimbach WN Jr : *Effect of lower body negative pressure on sympathetic discharge to leg muscles in humans. J Appl Physiol* 63 : 2558-2562, 1987
- 6) Seals DR : *Cardiopulmonary baroreflexes do not modulate exercise-induced sympathoexcitation. J Appl Physiol* 64 : 2197-2203, 1988
- 7) Scherrer U, Vissing SF and Victor RG : *Effects of lower-body negative pressure on sympathetic nerve responses to static exercise in humans : Microneurographic evidence against cardiac baroreflex modulation of the exercise pressor reflex. Circulation* 78 : 49-59, 1988
- 8) Joyner MJ, Shepherd JT and Seals DR : *Sustained increases in sympathetic outflow during prolonged lower body negative pressure in humans. J Appl Physiol* 68 : 1004-1009, 1990
- 9) Convertino VA, Tatro DL and Rogan RB : *Renal and cardiovascular responses to water immersion in trained runners and swimmers. Eur J Appl Physiol* 67 : 507-512, 1993
- 10) Nagaya K, Wada F, Nakamitsu S, Miki K, Sagawa S and Shiraki K : *Responses of circulatory systems and muscle sympathetic nerve activity to head-down tilt in humans. Manuscript, 1994*
- 11) 김형진 · 박재식 · 이원정 · 주영은 : 음주후 얼굴이 붉어지는 사람에 있어서 혈중 Ethanol 농도곡선의 분석 및 순환기능의 특성. *대한의학협회지* 28 : 1009-1024, 1985
- 12) Howes LG and Reid JL : *The effects of alcohol on local, neural and humoral cardiovascular regulation. Clin Sci* 71 : 9-15, 1986
- 13) 김윤년 · 이원정 · 주영은 : 에타놀이 체위변화에 대한 순환계 및 항이뇨호르몬의 반응에 미치는 영향. *계명대의논문집* 6 : 1-13, 1987
- 14) Zsoter TT and Sellers EM : *Effects of alcohol on cardiovascular reflexes. J Stud Alcohol* 38 : 1-10, 1977
- 15) Ireland MA, Vandongen R, Davidson R, Beilin LJ and Rouse IL : *Acute effects of moderate alcohol consumption on blood pressure and plasma catecholamines. Clin Sci* 66 : 643-648, 1984
- 16) Watson PE, Watson ID and Batt RD : *Prediction of blood alcohol concentrations in human subjects : Updating the Widmark equation. J Stud Alcohol* 42 : 547-556, 1981