CC5/14

APOLLO 14

EXERCISE-RESPONSE TEST

EXERCISE RESPONSE TEST

OBJECTIVE:

OBTAIN DATA ON CREWMEMBER'S CARDIOPULMONARY RESPONSE TO PHYSICAL EXERCISE:

1. CALIBRATION CURVES FOR INFLIGHT MONITORING
2. DETERMINE MECHANISM OF PHYSIOLOGICAL CHANGES

TEST PROTOCOL (HEART RATE CONTROLLED ERGOMETER):

BASELINE (REST)	- 5 Minutes
LIGHT WORK (120 HEART RATE)	- 6 Minutes
MODERATE WORK (140 HEART RATE)	- 3 Minutes
HEAVY WORK (160 HEART RATE)	- 3 Minutes
RECOVERY	- 3 Minutes

TEST MEASUREMENTS:

ECG
WORKLOAD
O_2 CONSUMPTION
MINUTE VOLUME
CO_2 PRODUCTION
BLOOD PRESSURE
RESPIRATION RATE
* CARDIAC OUTPUT

TEST SCHEDULE:

PREFLIGHT - F-30, F-14, F-4
** POSTFLIGHT - R+0, R+1

* Addition for Apollo 14
** Not done on Apollo 12 and 13

APOLLO EXERCISE RESPONSE TEST
OXYGEN CONSUMPTION IMMEDIATELY POSTFLIGHT
160 HEART RATE

	PREFLIGHT		POSTFLIGHT
$\bar{x}$	2.448 l/min		1.938 l/min
S.D.	.345		.323
N	15		15
$\bar{d}$		.510 l/min	
t		7.382 ($P < .001$)	

APOLLO EXERCISE RESPONSE TEST
OXYGEN CONSUMPTION AT 100 WATTS

	PREFLIGHT		POSTFLIGHT
$\bar{x}$	1.403 l/min		1.473 l/min
S.D.	.291		.214
N	15		15
$\bar{d}$		-0.070	
t		-1.032 (N.S.)	

APOLLO EXERCISE RESPONSE TEST
OXYGEN CONSUMPTION AT 50 LITERS/MINUTE VENTILATION

	PREFLIGHT		POSTFLIGHT
$\bar{x}$	2.044 l/min		1.860 l/min
S.D.	.263		.210
N	12		12
$\bar{d}$		0.183	
t		2.34 (N.S.	$P > .01$)

APOLLO EXERCISE RESPONSE TEST
SYSTOLIC BLOOD PRESSURE
160 HEART RATE

	PREFLIGHT		POSTFLIGHT
$\bar{x}$	201 mm. Hg		173 mm. Hg
S.D.	18		16
N	15		15
$\bar{d}$		29 mm. Hg	
t		8.30 ($P < .001$)	

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APOLLO 7-11 EXERCISE RESPONSE TEST

SUMMARY OF CHANGES

- TWELVE OUT OF FIFTEEN CREWMEN HAVE DEMONSTRATED A SIGNIFICANT DECREASE IN WORK PERFORMED AND OXYGEN CONSUMED AT SUBMAXIMAL LEVELS OF HEART RATE
- THREE OUT OF THREE CREWMEN HAVE DEMONSTRATED ABOVE RESPONSE AT MAXIMAL LEVELS OF HEART RATE
- RESPONSE HAS RETURNED TO PRE-FLIGHT VALUES WITHIN 24 TO 36 HOURS IN FOURTEEN OUT OF FIFTEEN CREWMEN
- CHANGES HAVE BEEN OBSERVED IN THE SYSTOLIC BLOOD PRESSURE CORRESPONDING TO SET LEVELS OF HEART RATE
- NO SIGNIFICANT CHANGES IN VITAL CAPACITY, FORCED EXPIRED VOLUMES, OR PEAK EXPIRATORY FLOW RATE WERE OBSERVED ON APOLLO 7 AND 8

CARDIAC OUTPUT

OXYGEN CONSUMPTION = (Heart rate x Stroke volume) x (A-V O_2 difference)

BLOOD PRESSURE = Peripheral resistance x $\frac{\text{cardiac output}}{}$

- NO CHANGE

  STROKE VOLUME DECREASE

  VENOUS RETURN

  Blood volume decrease
  Blood pooling

  MYOCARDIAL FUNCTION

  CHANGE IN PERIPHERAL RESISTANCE

- INCREASE

  STROKE VOLUME SAME
  CHANGE IN PERIPHERAL RESISTANCE

- DECREASE

  SAME AS NO CHANGE WITHOUT DECREASE IN PERIPHERAL RESISTANCE

CARDIAC OUTPUT MEASUREMENT

- NON-INVASIVE
- REQUIRES PROLONGED (5 SECOND) EXPIRATION AT END OF EACH STEP IN PROTOCOL
- UTILIZES MASS SPECTROMETER AND AUTOMATED RESPIRATORY GAS EXCHANGE EQUIPMENT