7:55 The day is April 5, 1951. It is 8:00 a.m. at the University of Minnesota Hospitals Dr. Dwight Spreng has just made the initial entry on this transcribed recording of the proceedings. It is proposed to used the mechanical heart-lung in a surgical support during operation for correction of an internal atrial septal defect. The patient's name Patty Anderson , age 6 years. In Dr. Hitchcock's machine is 500 cc of iron exchange blood and 500 cc of 5% glucose with 1 cc of heparin.

8:15 a.m. Final rinses of the machine are being carried out with normal saline which still shows a faintly positive spot test for formaldehyde. The patient being prepared in the operating room. Dr. Dennis and Dr. George Moore scrubbing.

8:23 a.m. Anesthesia initiated by Dr. Ralph Knight. Anesthesia by cyclopropane induction and planned to switch over to pentothal curare.

8:33 a.m. Skin prep being applied. The neosynephrine bottle has 100 cc of 5% glucose and 10 mgm of neosynephrine in it. The bicarb bottle has 100 cc of bicarb in it containing 7½ Gm. The machine transfusion bottle has in it about 2½ units of blood. Blood bank number 9020 number 9016, and number 9019. All reported as compatible. A RH positive.

8:59 a.m. Initial skin incision in left femoral area.

9:12 a.m. Artificial heart lung machine now fully prepared. The resevoir filled blood. The machine ready to be charged with blood. The machine resevoir has 1300 cc

in it, 6.6 cc heparin were added. No calcium.

9:30 a.m. Arterial oxygen saturation measured by earlobe cuvette. Is running about 85 to 86%. Anesthesia is ether with an endotrachial tube. Cannula is in place in the femoral artery.

9:43 a.m. A skin incision made on the chest by Dr. Dennis over the 3rd rib.

9:45 a.m. Arterial oxygen saturation approximately 95%.

10:00 a.m. Dr. Varco present. Systolic blood pressure running approximately 90 mm. of mercury. ~~Vena~~ MEAN arterial pressure is measured by cannula in the left femoral artery approximately 70 mm. of mercury. Arterial oxygen approximately 95% saturated.

10:15 a.m. Pleural opened.

10:20 a.m. Novacaine applied to pericardium.

10:21 a.m. Arterial pressure 90 mm. of mercury. Oxygen saturation approximately 96%.

10:25 a.m. Pericardium opened on the right. Novocaine instilled.

10:27 a.m. Pericardial adhesions to right atrium being freed.

10:29 a.m. Additional procaine instilled in pericardial sac. Patient given 125 mgm. pronestyol I.V.

10:31 a.m. ~~Vena~~ MEAN arterial pressure 60 mm. mercury.

10:32 a.m. Arterial oxygen saturation consisted at about 94%.

10:36 a.m. MEAN ~~Vena~~ arterial pressure 50 mm. of mercury. Peripheral blood pressured measured as 50/30. Arterial oxygen saturation 93.5%.

10:43 a.m. Right auricular appendage isolated. MEAN ~~Vena~~ arterial pressure 50 mm. of mercury. Oxygen saturation 93%.

10:46 a.m. Intra-arterial transfusion of approximately 25 cc of heparinized blood. The MEAN ~~Vena~~ arterial pressure remained at 50 mm. of mercury. Oxygen saturation 90%.

10:47 a.m. Procedure halted.

10:50 a.m. Completion of 50 cc of blood given intra-arterially. At the completion of this the main arterial pressure was slightly less than 70 mm. of mercury.

10:51 a.m. Procedure continued. Total intra-arterial blood was 50 cc.

10:52 a.m. MEAN ~~Vena~~ arterial pressure approximately 50 mm. of mercury. Oxygen saturation 89%. Additional intra-arterial blood being given.

10:53 a.m. Exposure of superior vena cava. Anesthesia mixture changed to 600, Nitrous oxygen to 500, it had been previously 500 to 500, Oxygen saturation at 10:54 88.5%.

10:54 a.m. An additional 50 c.c. of blood has been given intra-arterially.

10:55 a.m. Systolic pressure reported as 60 mm. of mercury. Tape placed around superior vena cava. Mean arterial pressure recorded as 50 mm. of mercury.

10:58 a.m. Azygos vein isolated. Oxygen saturation 88%. Mean arterial pressure 50 mm. of mercury.

10:59 a.m. Lung expanded.

11:00 a.m. Mean arterial pressure has risen to 55 mm. of mercury. Oxygen saturation is 88.5%. Attention being directed toward the inferior vena cava. Room temperature 80; humidity 60%.

11:04 a.m. Mean arterial pressure 60 mm. of mercury; systolically reported as 70. Arterial saturation 88%.

11:07 a.m. Arterial saturation 88.5. Mean arterial pressure 60 mm. of mercury.

11:13 a.m. Arterial saturation 86.5%. Mean arterial pressure slightly less than 60 mm.

11:17 a.m. Dr. Knight reports the pulse has slowed to about 76 per minute. Mean arterial pressure at this time is 60 mm. of mercury.

11:19 a.m. Oxygen saturation 84%. An additional skin incision is being made over the right lower chest to facilitate approach to the inferior vena cava. Anesthesia changed to 700 oxygen and 500 nitrous.

11:23 a.m. Mean arterial pressure 75. Oxygen saturation 84.5. This rise in arterial pressure is probably associated with the cessation of manipulation around the great vessels.

11:27 a.m. Arterial saturation 90%.

11:29 a.m. Oxygen saturation 86.5%. Previous reading should be corrected to approximately 86%. Some difficulty is being experienced in the operation of the interarterial cannula.

11:31 a.m. Interarterial mean pressure recorded as 75 mm. of mercury.

11:35 a.m. Inferior vena cava finally isolated by means of the accessory incision. Oxygen saturation recorded as 86%. Mean arterial pressure 75 mm.

11:37 am. Attention redirected to the primary chest wound. Approach being directed now toward the subclavian artery. on the left.

11:49 a.m. Oxygen saturation 86%. Mean arterial pressure recorded as 80 mm. of mercury. Dissection was unable to free up the left subclavian so attention was directed to the right subclavian which will be used for arterial return.

11:51 a.m. Right subclavian has been tied off and branches are now being tied off. Blood pressure is remaining steady at 80./ 12:05 p.m. The right subclavian is divided. The mean arterial blood pressure is 80 mm. of mercury. The oxygen saturation is at the present 88. 200 c.c of plastic bag drawn blood with 3 mg. of heparin added being used to fill the tubing on the table preparatory to connecting up the cannulas in the arteries.

12:09 p.m. Arterial saturation recorded as 84%. This reading is the line of 3.4 on the graph. Mean arterial pressure is 80 mm. of mercury. As the cannulae are now being prepared for connection to the great vessels, final preparations of the machine are also being made. The heart-lung machine as being charged at 12:11 p.m. with approximately 1300 ml. of ion exchange blood to which 52 mg. of heparin have been added.

12:12 p.m. The cannulae and tubing have been filled with blood from a beaker containing approximately 200 ml. of ion exchange chamber blood to which 3 mg. of heparin had been added. Less than 100 c.c. was necessary to fill the tubing.

13:13 p.m. The cannula is being placed in the right subclavian artery. Arterial saturation at this time is noted to be 84%. Mean arterial pressure 70%.

12:15 p.m. The heart-lung apparatus has been moved into the main operating. The resevoir contains the heparinized blood previously described.

12:16 p.m. The cannula on the right subclavian artery was cleared of their normal arterial pressure. The tip of this cannula is beyond the carotid and into the innominate artery.

12:16 p.m. 19 mgm of heparin have been given intravenously.

12:20 p.m. Attention directed toward the azygos vein preparatory to inserting cannula.

12:22 p.m. Oxygen saturation recorded as 84% that is line 3.4 on the graph. The mean arterial pressure is 70 mm. mercury. The machine resevoir has approximately 1300 cc of blood in it. 5.T cc of heparin were added, 100 mgm of aureomycin, and 500,000 units of penicillin.

12:29 p.m. Oxygen saturation 83%. Mean arterial pressure 75mm. mercury.

12:31 p.m. The azygos vein was found to be very small in diameter, would not accept the catheter which we planned to use. An improvised catheter with a straight stainless steel cannula is being prepared and will be inserted.

12:33 p.m. Oxygen saturation 80%. Mean arterial pressure 70 mgm of mercury. Dr. Knight reports the earlobe very edematous. Therefore, the light cell was turned off for a brief period.

12:45 p.m. Mean arterial pressure 70 mm. of mercury. Great difficulty being experienced in canmulating the azygos vein which is very small. The oxymeter recording was restarted and showed 80% of saturation. Because of this low oxygen saturation, Dr. Knight changed the mixture to 800 oxygen with 500 nitrous.

12:49 p.m. The pulses observed as remaining fairly stable at about 100 per minute with one recent rise to 106 per minute.

12:50 p.m. Note on the bank blood which was used to charge of the machine and the canmulae. Three bottles marked as follows: Blood bank, #9014, 9015 and 9022, all a positive.

12:53 p.m. Oxygen saturation recorder again turned on;reading was 79%. The patient received 100 mgm pronestrol I.V.

1:01 pm. Venous cannula still not in place. Clotting time taken from the subclavian canmula.

1:06 p.m. Preparing to take a stab wound in the right atrium and introduce a venous cannula.

1:07 p.m. Arterial saturation recorded as 79%. The Dennis-Karlson artificial heart-lung being charged with blood.

1:09 p.m. The patient received 50 cc intra-arterial transfusion. Mean arterial pressure recorded now as 70 mm. mercury.

1:10 p.m. 9.9 cc of 10% calcium gluconate added to the blood in the machine.

1:12 p.m. 20 mgm of heparin given intravenously. The clotting time on a sample of blood prevously described was reported as showing soft clots in ten minutes.

1:14 p.m. Pre-perfusion control taken from the arterial cannula. Oxygen saturation approximately 78%. Mean arterial pressure recorded as 70 mm. of mercury.

1:15 p.m. The machine moved in close proximity to the table and arterial cannula connected to the arterial pumps of the machine.

1:18 p.m. The venous cannulae tubing was connected to the machine.

1:21 p.m. The last air bubble removed from the arterial cannula.

1:22 p.m. Stab wound made in right atrium.for introduction of venous cannula. Arterial pressure at this time recorded as 70 mm. of mercury. Oxygen saturation 77%.

1:23 p.m. The machine is started with one venous cannula in place. The one cannula being in place in the superior vena cava. The mean arterial pressure showed a fall to 60 mm. of mercury. Arterial saturation is approximately 77. Flow rate ~~Chlorate~~ is reported as 1100 millilaters per minute.

1:25 p.m. The mean arterial pressure reported as 65 mm. The machine is using only 4 jets and 4 discs.

1:26 p.m. The mean arterial pressure 70. 77% saturated.

1:27 p.m. Attempt being made to insert the cannula in the inferior vena cava. The cannula and superior vena cava is in place. Circulation is being incompletely carried.

1:27,30 p.m. sec. The cannula is in place in the inferior vena cava; however, the vena cava is not yet tied around the cannula.

1:28 p.m. The mean arterial pressure 70. Arterial saturation 76%.

1:29 p.m. Flow rate reported 1300. Mean arterial pressure approximately 85. Arterial venous difference on gross observation on the machine is reported as good.

1:29½ The inferior vena cava was tied around the cannula.

1:30 p.m. Arterial oxygen saturation as 75.5%. Flow at this time is reported as 1400.

1:31 p.m. Mean arterial pressure 80. Oxygen saturation 75%. The flow rate at this time was reported as 1400 milliliters per minute.

1:32½ p.m. Incision made to expose the coronary sinus and introduce cannula. The right atrium is opened.

1:33 p.m. The coronary sinus cannula in place. Flow reported as 1.5 liters per minute.

1:34 p.m. Right atrium is wide open. Suction tip is being used to remove excess blood which is being returned to the Dennis-Karlson machine. Mean arterial pressure 1:34 p.m. was 85 mm. of mercury. The oximeter ran out of recording paper.

1:35½ p.m. The oxygenator is being supplied with 14 liters of oxygen per minute and at this time 1,000 c.c. of nitrous oxide was added. 450 cc CO_2

1:36 p.m. Flow is 1,550 ml. per minute.

1:37 p.m. The atrial septal defect being repaired. Mean arterial pressure 95 mm. of mercury. The oxygen saturation although not recording the needle appears to

be in the position of about 75% saturation.

1:38 p.m. The 15 minute sample is taken.

1:39 p.m. Mean arterial pressure approximately 95 mm. of mercury. Saturation approximately 72%. Coronary sinus catheter out temporarily. The catheter is back in the sinus again.

1:41 p.m. Coronary sinus catheter out.

1:42 p.m. Mean arterial pressure is 95 mm. of mercury. Stitching the distal-most portion of the atrial septal defect.

1:43 p.m. Mean arterial pressure 100 mm. of mercury. Flow through the machine reported as holding approximately even. 10 mg. of heparin were added to the blood.

1:44 p.m. Microphone to the field and Dr. George Moore. 6 sutures through the

1:45 p.m. The ~~oxygenator~~ OXIMETER reported not working at this point but the needle indicates approximately 70% saturation. The mean arterial pressure is approximately 100 mm. of mercury. Additional ACD blood is being poured into the machine. The flow is approximately 1580 ml. per minute. No neosynephrine is running at the present time since the mean arterial pressure is 105 mm. mercury pressure.

1:46 p.m. The mean arterial pressure approximately 95 mm. of mercury. Oxygen saturation at this time is approximately 68%. Oxygen saturation appears to be falling. Heart rate is decreasing.

1:47 p.m. Microphone to the field and Dr. George Moore. The catheter out of the coronary sinus. Trying to get the last stitch in. There are now 8 stitches in the defect.

1:48 p.m. Changed to about 18 liters of oxygen, 300 c.c. of CO_2. Flow rate 1.7 liters per minute. The mean arterial pressure approximately 100 mm. of mercury.

1:49 p.m Oxygen saturation approximately 70%. Flow rate 2100. Mean arterial pressure 110 mm. of mercury.

1:49½ p.m. Flow rate 2400. Mean arterial pressure 100. Five discs are being used. Holding appears to be good.

1:50 p.m. The flow rate was 2400. Oxygen saturation at this time was 68%.

1:50½ p.m. The flow rate 2600 ml. per minute. Mean arterial pressure approximately 100 mm. of mercury.

1:51 p.m. Flow rate 2750 ml. per minute. Mean arterial pressure 100 mm. of mercury. Oxygen saturation at this time is approximately 70%.

1:52 p.m. Gross observation of the saturation in the discs appears to be good and to have improved. The oxygen saturation recorded was judged not to be accurate because of the marked edema which had occured in the ear lobe. The flow rate approximately 2600 c.c. per minute. The mean arterial pressure 100 mm. of mercury.

1:54 p.m. Flow rate 2350 ml. per minute.

1:55 p.m. The mean arterial pressure is 110. Pulse rate plus 72 per minute.

Flow rate 2550 ml. per minute. Microphone to the field and Dr. George Moore.

Three more stitches placed in the defect toward the coronary sinus.

1:56½ p.m. Heart is quiet and regular. The last part of the aperture is closed. Apparently 11 sutures. Defect is about 4 cm. and "S" shaped.

1:59 p.m. (Dr. Moore). One more stitch taken in the corner near tricuspid valve.

Part of the tricuspid open has been compromised on the medial aspect. The flow rate is reported as 2450 ml. per minute. The mean arterial pressure is fluctuating between 90 and 100 mm. of mercury. Gross oxygenation in the screen disc apparatus looks good.

2:00 p.m. Atrial defect has been closed with [illegible] around the three intake catheters.

2:01 p.m. 1/400 grain atropine was given intravenously. The tie is removed from the inferior vena cava. The cannula was removed. Flow rate on the machine was decreased to 1800 ml. per minutes.

2:02 p.m. Superior cannula is out. The coronary sinus is out. The mean arterial pressure is 70 mm. of mercury. The superior vena cava cannula has been removed.

2:02½ p.m. (Dr. Moore). The heart beat is very, very faint.

2:03 p.m. Dr. Knight resumes pumping the lung manually. Final samples are being taken.

2:04½ p.m. The mean arterial pressure is stimulated by cranking the arterial pump of the

2:06 p.m. There was a little wiggle. No it's all right, Dr. Varco. I don't know what it was, it wasn't due to the heart because the heart

machine. Reported to be 70 to 80 mm. of mercury.

2:06 p.m. (Dr. Moore) Process, massaging heart. Microphone open in the field. Cardiac massage being performed. Venous pressure very high. The mean arterial pressure reported as 65 mm. of mercury.

2:07 p.m. Perforation is made to open the chest longitudinal fashion in order to facilitate massage of the heart.

2:08 p.m. The heart is completely exposed. Adrenalin injected into the myocardium.

2:08½ p.m. Mean arterial pressure 70 mm. of mercury. The subclavian cannula is still in place.

2:09½ p.m. Manual massage of the heart continued. Weak contraction seen.

2:11 p.m. Cardiac massage continued. Additional adrenalin injected into the heart. Weak contractions seen. Strength of the adrenalin was 1:40,000. Additional 5 c.c. given at 2:11½ p.m. Cardiac massage continued.

2:12½ p.m. Massage interrupted for inspection of the heart. Weak contractions seen. The mean arterial pressure at this time is approximately 45.

2:13½ p.m. Arterial pumps cranked manually. Pressure elevated to 90 mm. of mercury.

2:14½ p.m. Heart observed for approximately 30 seconds while electrocardiograph studies were made. A weak, fairly regular beat was seen.

2:16 p.m. Massage interrupted for 15 seconds. Weak contraction seen again. A small

amount of blood pumped in by manual rotation of the arterial pump crank.

2:16½ p.m. Pressure was 80 mm. of mercury.

2:17½ p.m. Cardiac massage continued by Dr. Moore.

2:19 p.m. Only weak contraction seen when cardiac massage is interrupted.

2:19½ p.m. Mean arterial pressure 50. Manual rotation of pumps introduced blood into the subclavian cannula. Pressure elevated to 75 mm. of mercury.

2:23 p.m. Cardiac massage interrupted. Very weak contractions seen over the ventricles.

2:23½ p.m. Blood pumped in by mamual rotation out of pumps in an attempt to maintain coronary circulation.

2:25½ p.m. Blood being pumped in by cranking. Massage continued by Dr. Dennis.

2:26 p.m. Mean arterial pressure was approximately 90 mm. of mercury.

2:27 p.m. Cardiac massage interrupted to observe nature of the beat. Somewhat stronger but still very weak.

2:28 p.m. Cardiac massage being continued. The mean arterial pressure about 85.

2:29½ p.m. Neosynephrine, 1/4 c.c., intra-arterially. Mean arterial pressure approximately 85.

2:30 p.m. The heart is very large. There is a fair amount of blood in the chest. Weak ventricular contractions were seen.

2:31 p.m. It was felt that no recovery at this point was possible.

2:33 p.m. The heart was more completely exposed and what appeared to be fibrillary waves

were seen on its surface. Electrocardiographic tracing was taken at this time.

2:34 p.m. Additional blood is being given intra-arterially. Arterial pressure which had been recorded as 0 or 10 mm. of mercury was then observed to rise to about 50 mm.

2:40 p.m. Massage of the cardiac musculature has been continued but no strong contractions have been seen.

2:43½ p.m. Suction tip introduced into the atrial wound. Large amounts of blood evacuated.

2:45 p.m. Pulmonary resuscitation efforts through manual bag breathing were ceased.

2:49 p.m. The atrium was opened and the site of septal repair examined. During the perfusion, 25 c.c. of sodium bicarbonate, 30 c.c. of neosynephrine were used. This neosynephrine consisted of 1 c.c. diluted in 100 c.c. of glucose. ~~using positron-emitters~~.