



Staff Meeting Bulletin  
Hospitals of the » » »  
University of Minnesota

Patent Ductus Arteriosus

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William A. O'Brien, M.D.

I.

UNIVERSITY OF MINNESOTA MEDICAL SCHOOL  
 CALENDAR OF EVENTS

No. 44

October 28 to November 4  
 Visitors Welcome

Monday, October 30

- 9:00 - 10:00 Roentgenology-Medicine Conference; L. G. Rigler; C. J. Watson and Staff, Todd Amphitheater, U. H.
- 9:00 - 11:00 Obstetrics and Gynecology Conference; J. L. McKelvey and Staff, Interns Quarters, U. H.
- 12:30 - 1:30 Pathology Seminar; Renal Lesions in Diabetes; E. T. Bell, 104 I.A.

Tuesday, October 31

- 9:00 - 10:00 Roentgenology-Pediatrics Conference; L. G. Rigler, I. McQuarrie and Staff, Eustis Amphitheater, U. H.
- 11:00 - 12:00 Urology Conference; C. D. Creevy and Staff, Main 515, U. H.
- 12:30 - 1:30 Pathology Conference; Autopsies; Pathology staff, 104 I.A.
- 12:30 - 1:30 Physiology-Pharmacology Seminar; The Intestinal Absorption of Water and Electrolytes; The Fluid Circuit Theory of Water and Electrolyte Absorption by the Intestine, Applied to Earlier (non-isotopic) data; F. Kottke, 214 M. H.
- 4:30 - 5:30 Obstetrics and Gynecology Conference; J. L. McKelvey and Staff, Station 54, U. H.
- 4:00 - 5:00 Pediatrics Grand Rounds; I. McQuarrie and Staff, W-205 U. H.
- 4:30 - 5:30 Ophthalmology Ward Rounds, Erling Hansen and Staff, E-534 U. H.
- 5:00 - 6:00 Roentgen Diagnosis Conference; G. M. Kelby, T. B. Merner, 515-M, U.H.

Wednesday, November 1

- 9:00 - 11:00 Neuropsychiatry Seminar; J. C. McKinley and Staff, Station 60, Lounge, U.H.
- 11:00 - 12:00 Pathology-Medicine-Surgery Conference; Peritonitis and Uremia; C. J. Watson, O. H. Wangenstein and Staff, Todd Amphitheater, U. H.
- 12:30 - 1:30 Pediatrics Seminar; Pathological Conference (Pediatric Cases), Dr. Costaneda, W-205 U. H.
- 12:30 - 1:30 Physiological Chemistry Literature Review; Staff, 116 M.H.
- 12:30 - 1:30 Pharmacology Seminar; Incidence, Pathology and Diagnosis of Wucheria Bancrofti Infections; H. N. Wright; 105 M.H.
- 4:30 - 5:30 Neurophysiology Seminar; The Physiology of the Semi-Circular Canals in the Light of Action Potential Studies; H. William Kubicek, 214 M.H.

Thursday, November 2

- 9:00 - 10:00 Medicine Case Presentation; C. J. Watson and Staff, Todd Amphitheater, U. H.
- 12:30 - 1:20 Physiological Chemistry Seminar; Application of Spectrophotometric Methods to the Study of Oxidation Reduction Systems; Donald Clausen; 116 M. H.
- 4:30 - 5:30 Ophthalmology Ward Rounds; Erling Hansen and Staff, E-534, U. H.
- 5:00 - 6:00 Roentgenology Seminar; Neurofibromatosis of Bone; L. P. Anderson; M-515 U. H.

Friday, November 3

- 9:00 - 10:00 Medicine Grand Rounds; C. J. Watson and Staff; Todd Amphitheater, U.H.
- 8:30 - 10:00 Pediatrics Grand Rounds; I. McQuarrie and Staff, W-205 U. H.
- 10:00 - 12:00 Medicine Ward Rounds; C. J. Watson and Staff; East 214 U. H.
- 10:30 - 12:30 Otolaryngology Case Studies; L. R. Boies and Staff, Out-Patient Otolaryngology Dept.
- 11:45 - 1:15 University of Minnesota Hospitals General Staff Meeting; Hearing Loss; L. R. Boies, Powell Hall Recreation Room
- 1:30 - 2:30 Medicine Case Presentation; C. J. Watson and Staff, Eustis Amphitheater, U. H.
- 1:00 - 2:30 Dermatology and Syphilology; Presentation of selected cases of the week; Henry E. Michelson and Staff; W-306 U. H.
- 1:30 - 3:00 Roentgenology-Neurosurgery Conference; H. O. Peterson, W. T. Peyton and Staff, Todd Amphitheater, U. H.

Saturday, November 4

- 8:00 - 9:00 Surgery Journal Club; O. H. Wangensteen and Staff, Main 515 U. H.
- 9:15 - 10:30 Surgery-Roentgenology Conference; O. H. Wangensteen, L. G. Rigler and Staff, Todd Amphitheater, U. H.
- 9:00 - 10:00 Medicine Case Presentation; C. J. Watson and Staff, Main 515 U. H.
- 10:00 - 12:00 Medicine Ward Rounds; C. J. Watson and Staff, E-214 U. H.
- 11:30 - 12:30 Anatomy Seminar; Paulo Seabra's (Rio de Janeiro) Experiments with the Oxidase Reaction; Hal Downey; Origin of the Lymphocytes in the Thymus; Ruby M. Engstrom; I. A. 226

## II. PATENT DUCTUS ARTERIOSUS - THE PRE-OPERATIVE DIAGNOSIS

M. J. Shapiro

### Introduction

When I think of the surgical treatment of heart disease my feelings must be like those of a medical student seeing his first Caesarian section. Now I am told that the ligation of a patent ductus arteriosus is not a complicated procedure for an experienced surgeon. It is obvious that not every one should make this exploration for the number of individuals involved is not great. Finding these patients is another matter and Dr. Shapiro in his presentation today gives us clearcut information as to how this may be done. Modern medicine at its best consists of diagnosis, medical management, treatment of minor surgical disorders and disposition of major surgical procedures beyond the scope of the individual's training and experience. The recent issues of the Journal of the American Medical Association have contained much of interest in this field. We are re-quoting the editorial from the October 14, 1944 issue, entitled "The Reversibility of Heart Disease". (Editor).

"Recently Dr. Paul Dudley White called attention to the extent of the reversibility of heart disease in the annual oration in medicine before the Illinois State Medical Society. Twenty years ago Hamilton and Lahey proved that serious thyrocardiac disease, now almost unknown, could be dispelled by subtotal thyroidectomy; the cardiac enlargement and failure in such cases had previously been considered risks too hazardous for surgery. Since that time every kind of heart disease has been shown to be reversible, in at least a small proportion of cases, either spontaneously or by surgical or medical treatment. This is a different situation from that recalled by White, who states that some thirty years ago when he was medical student, intern and hospital resident "it was still being taught and believed that heart disease was final and fatal, that the coronary arteries were forever

'end arteries' and that at best we could simply delay a little the day of dissolution and make a bit more comfortable the remaining hours of the victims."

Following the demonstration of the reversibility of thyrotoxic heart disease and of the cardiac enlargement of myxedema, the reversibility of various other conditions has been proved. In 1928 the first case in this country of cure of chronic constrictive pericarditis by pericardial resection was carried out by Churchill; since that time relief has been given in many other cases. Some 10 years ago it was realized cardiac dilatation due to acute rheumatic myocarditis could entirely subside with disappearance of mitral diastolic as well as of mitral systolic murmurs. Aneurysms, saccular and arteriovenous, have been attacked successfully by wiring or excision. Coronary heart disease, one of the most important of all types, has been shown to be reversible also, primarily through the spontaneous development of an adequate collateral circulation. Thus myocardial infarction and indeed also angina pectoris in many cases may exist merely as acute or sub-acute illnesses and not necessarily as chronic disabilities. The acute cor pulmonale consisting of dilatation of the right heart chambers may quickly subside on recovery from the immediate effects of massive pulmonary embolism. Cardiac dilatation and even failure found in acute hemorrhagic nephritis, avitaminosis of the B<sub>1</sub> type and severe anemia may also subside, with recovery from these underlying diseases.

Six years ago congenital heart disease joined the ranks of the types of reversible heart disease, when Gross of Boston successfully ligated the patent ductus arteriosus; since then, in a good many cases, cardiac strain and dilatation have been relieved by this procedure. Subacute bacterial endocarditis has been yielding slowly but definitely to chemotherapy, first in slight degree to the sulfonamides and now apparently more successfully to massive doses of penicillin. Finally, the last of the types which was thought not long ago to be particularly irreversible, namely

hypertensive heart disease, is now being relieved on occasion by the more extensive splanchnic resection carried out by Smithwick.

Dr. White concludes: "Where does this all lead us? In two directions: first and most obviously, along our continued optimistic search for still further chances and methods of reversing the evidences of heart disease, and second and still more importantly, in our attacks on the causes of heart disease, such as hypertension, before the heart itself is affected. That is our ultimate goal in cardiology, as in all fields of medicine, prevention rather than cure!"

#### The Pre-Operative Diagnosis

Since it is now possible to cure patent ductus arteriosus by surgery it is of utmost importance that the correct diagnosis be made, lest we subject patients unnecessarily to a major surgical procedure. Furthermore, in order that patients with simple uncomplicated patency of the ductus may not be denied the opportunity of surgical cure the correct diagnosis must be made as early in life as possible. Since the first successful ligation of a patent ductus by Gross in 1938 a number of patients have been referred to us for surgical treatment, who on examination were found to have various types of congenital heart lesions, but did not have patent ductus arteriosus. By far the great majority of patients who have come under our observation have not been diagnosed correctly until they were of school age or older. In most instances these patients were referred to the heart clinic because a murmur was found during the school physical examination. Too often the parents of these children have been told by their family physician or pediatrician that the child, "would outgrow the condition." It is for these reasons that a discussion of the various aspects of the diagnosis of patent ductus arteriosus is timely and important.

In utero, the ductus arteriosus is a vessel of considerable size which acts as a by-pass directing the blood away from the fetal lungs and carries blood

from the pulmonary artery to the aorta. In the normal new-born the ductus closes within a few minutes after the first breath is taken. Recent work indicates that failure of closure in uncomplicated cases of patent ductus arteriosus may result from lack of oxygenation of the blood, possibly due to obstruction of the air passages in the newly born infant. Continued research must be carried on before this theory is acceptable.

Two types of patency of the ductus may occur. The duct may remain open as part of a serious developmental defect and may act as the only means of carrying on circulation in a heart seriously impaired by other congenital defects. Such patients have unmistakable congenital heart disease and are commonly born cyanotic, although patency of the ductus may occur in non-cyanotic cases. This type of lesion cannot be treated surgically or in any other way. In the type of case which is curable by surgery the patent ductus is the only defect present. The heart is otherwise normally developed. These patients are never cyanotic. Strictly speaking the uncomplicated isolated patency of the ductus is not a congenital lesion as it occurs after birth and has nothing to do with developmental defects of the heart.

We have had under observation for a variable number of years sixty-two patients in whom a definite diagnosis of uncomplicated patent ductus arteriosus could be made.

#### Sex and Age Incidence

Of these sixty-two patients forty-seven were females and fifteen were males (Table 1). In all series of cases

Table I

	Cases Studied	
Females	47	
Males	15	Total 62

Age of Patients when Last Examined					
0-10	10-20	20-30	30-40	40-50	50-60
18	27	10	4	1	2

Number of Years Followed		
0--5	5--10	10--20
35	15	12

reported this same preponderance of females is present. This is more than an accidental finding but there seems to be no clear-cut explanation for this sex preponderance.

When these patients were last examined eighteen of them were up to ten years of age, twenty-seven were between ten and twenty years of age, ten between twenty and thirty, four between thirty and forty, one between forty and fifty, and two between fifty and sixty. All of our patients over the age of forty are now dead. The diagnosis of patent ductus arteriosus in infants under the age of two is ordinarily hazardous; however, where the findings are characteristic the diagnosis can be made with certainty even at this age. A study of the literature indicates that while patients over the age of forty with patent ductus arteriosus are occasionally reported it is nevertheless true that it is quite rare for patients over this age to be discovered in heart clinics. As previous studies have revealed most of such patients die either of subacute bacterial endarteritis or congestive heart failure in early adulthood. Thirty-five of our patients have been observed up to five years, fifteen between five and ten years, and twelve between ten and twenty years.

#### Clinical Characteristics

Stunting of growth has been considered a typical finding in patients with patent ductus arteriosus. The retardation of growth results from the shunting of blood from the peripheral circulation into the pulmonary circulation. However, in our experience a stunting of growth is not always found and as a matter of fact some of the more serious cases with definite evidence of cardiac strain have shown no abnormality of growth. Thirty-three of our patients (Table 2) have been normally developed, twenty three were undersized, and six were obese. On physical examination the most characteristic finding in this lesion is the so-called machinery murmur, which is commonly heard over the first or second interspace just to the left of the sternum. This murmur is pathognomonic and once heard is easily

Table 2

#### Clinical Characteristics in 62 Patients with Patent Ductus Arteriosus

<u>Nutrition</u>	
Normal	33
Stunted	23
Obese	6
<u>Murmur</u>	
Machinery murmur	61
No murmur	1
<u>Thrill</u>	
Present	53
Absent	9
<u>Pulse Pressure</u>	
Normal	14
High	48

recognized. The murmur is continuous throughout the heart cycle and within the murmur an accentuated pulmonic second sound is usually heard.

With our present knowledge it is our feeling that a diagnosis of patent ductus arteriosus cannot be made unless this characteristic machinery murmur is present. A study of the older literature will reveal the statement that patent ductus arteriosus can occur in patients in whom only a systolic murmur is heard. This is not true. In our experience all of our patients who have been studied either at the operating table or at post mortem and in whom the diagnosis has been verified have all had this characteristic murmur, with one exception and in this case no murmur at all was heard. It is our feeling that no patient should be subjected to surgery unless the machinery murmur is present. In our series of cases sixty-one patients had this murmur, while in one instance in a patient forty-nine years of age in whom a very large open ductus was found at post mortem, no murmur was found at all. A thrill, palpable over the point of maximum intensity of the murmur, is usually present. Fifty-three of our patients had this thrill, in nine instances no thrill was palpable.

The peripheral vascular findings will vary in accordance with the size of the ductus. In patients in whom the ductus is small the pulse pressure may be normal; however, in those individuals in whom there is any considerable leak through the open ductus the peripheral vascular findings will be much the same as those found in aortic regurgitation--that is, increased pulse pressure, pistol shot femorals, capillary pulse, etc. In fourteen of our patients the pulse pressure was found normal, in forty-eight there was a definite increase in pulse pressure and in these the accompanying characteristic peripheral vascular findings were noted.

#### Electrocardiographic Findings

The electrocardiogram in patent ductus arteriosus is important from a negative point of view. In the uncomplicated lesion the electrocardiogram is invariably within normal limits. Occasionally one finds a slight right or slight left axis deviation and there may also be present slight slurring in one or two leads. However, if a marked right axis deviation is found the diagnosis of an uncomplicated patent ductus arteriosus should be seriously questioned. This is also essentially true when a marked left axis deviation is found. In our series fifty-two patients had normal findings (Table 3), five had a slight left axis deviation, one slight right axis deviation, and four had other slight changes.

Table 3

#### Electrocardiography Findings

Normal	52
Left axis deviation (slight)	5
Right axis deviation (slight)	1
Other changes	4

#### X-Ray Findings

Roentgen studies are of great value not only in making the diagnosis of patent

ductus arteriosus, but also in observing the progress of the individual case. A great deal can be learned in regard to the severity of the leak and the amount of cardiac strain present by x-ray observation. In those patients with small ducts the heart may be within normal limits as to size. There is almost always a slight enlargement of the pulmonary trunk. This small enlargement of the pulmonary trunk may be apparent only on fluoroscopic examination or by obtaining films in oblique views. In patients with larger ducts and in whom there is considerable leak from the aorta into the pulmonary artery, there will be found enlargement of both the left and right ventricle, as well as moderate to marked enlargement of the pulmonary trunk, as well as the branches of the pulmonary artery in the lungs.

On fluoroscopic examination these pulmonary branches will be seen to pulsate (Table 4). In twenty-two of our patients no enlargement of the heart was discovered, twenty-one had slight enlargement, fifteen had moderate enlargement, and four had marked enlargement of the heart. In ten instances no evidence of enlargement of the pulmonary artery could be made out, thirty-six had slight enlargement, fifteen moderate, and one marked. In thirty-six instances there was no enlargement of the pulmonary branches, thirteen slight, twelve moderate, and one marked.

Table 4

#### X-Ray Findings

	<u>Enlarge- ment of Heart</u>	<u>Enlarge- ment of Pulmonary Artery</u>	<u>Enlarge- ment of Pulmon- ary Vessels</u>
None	22	10	36
Slight	21	36	13
Moderate	15	15	12
Marked	4	1	1



### Diagnostic Verification

We have had the opportunity of checking our diagnosis in twenty-three instances, (Table 5). In nineteen patients who have been operated a patent ductus was found in each instance.

Table 5

#### Diagnostic Verification

	<u>No.Cases</u>	<u>Errors</u>
By Operation	19	0
By Postmortem (3 operated)	7	0

Three of these patients died and were further studied post mortem. In four patients who died of this lesion and were studied post mortem, the diagnosis was correct in each instance, so that up to the present writing no errors in diagnosis have been made in our clinic.

Table 6

#### Diagnostic Criteria

1. Machinery Murmur
2. Thrill in Pulmonary Area
3. Enlarged Pulmonary Artery
4. Enlarged and pulsating  
Pulmonary Vessels
5. Enlarged Heart
6. Increased Pulse-Pressure
7. Stunting of Growth
8. Absence of Cyanosis and  
Clubbing of Fingers
9. Normal Electrocardiogram
10. History of heart disease  
from early childhood.

### Differential Diagnosis

A correct anatomical diagnosis in congenital heart disease is possible in most patients who live beyond the period of early childhood. The differential diagnosis between congenital and acquired heart disease is usually not difficult. After the diagnosis of congenital heart disease has been made it is important

to make an exact anatomical diagnosis because there is considerable difference in prognosis among the various types of lesions. Too often a child with a loud harsh murmur in the heart of congenital nature is forced into almost complete inactivity due to a gloomy prognosis when a knowledge of the exact type of congenital defect would have lead to a good prognosis with no limitation of activity.

The diagnosis of congenital heart disease is based on the following:

1. History of heart disease from birth or early childhood.
2. In some cases the characteristic cyanosis and clubbing of the fingers. (The great majority of these patients have no cyanosis or clubbing of the fingers.)
3. Murmurs in the heart of bizarre nature, usually harsh and prolonged and usually transmitted better than murmurs due to valvular disease. It is not uncommon to hear such murmurs down the humerii, along the spinal column and even on top of the head.
4. In many cases a marked thrill is palpable.
5. Characteristic x-ray configuration of the heart.
6. Electrocardiographic changes which corroborate clinical and x-ray findings.

#### Classification of Congenital Heart Disease (after Abbott)

- A. Non-cyanotic
  - I. Acyanotic (No abnormal circulation exists, therefore, no reason for cyanosis)  
Example: 1. Coarctation of aorta.
  - II. Cyanose tardive (Abnormal communication exists between arterial and venous circulation; cyanosis occurs only if pressure in right heart becomes greater than that in left causing a venous-arterial shunt)  
Examples: 2. Patent interventricular septum  
3. Patent interauricu-

- lar septum  
4. Patent ductus arterio-  
sus.

B. Cyanotic (Permanent cyanosis caused by direct admixture of venous and arterial blood through a venous-arterial shunt)

Example: 5. Tetrad of Fallot (Pulmonary stenosis, patent interventricular septum, dextroposed aorta receiving blood from both ventricles and enlargement of right heart)

### Typical Cases.

#### 1. Coarctation of Aorta

Age 9. Has been under observation at Clinic for 3 years. Always well. No history of congenital heart disease in family. No history of rheumatic infection. Was referred to the Clinic by school physician because of murmur in his heart.

Physical examination reveals a well developed, well nourished boy who looks unusually well and has no complaints. No cyanosis or clubbing of fingers. Face appears flushed. Vessels of neck pulsate rather markedly. Inspection of chest reveals pulsating vessels in interscapular region. On palpation a number of enlarged vessels are felt especially in interscapular area and on anterior upper chest. Auscultation over these vessels reveals a late systolic typically hemic murmur. No thrill is made out over heart. Heart is moderately enlarged to left. Along left border of sternum a short systolic murmur is heard. Second aortic sound is moderately accentuated. Heart sounds are regular and of good quality. Blood pressure right arm systolic 144, diastolic 100; left arm systolic 134, diastolic 100; left leg systolic 100, diastolic 80; right leg systolic 100, diastolic 90. Skin temperature is definitely higher in upper half of body. Difference in temperature can be made out with bare hand.

Six foot film reveals slight enlargement of heart mostly in region of left ventricle. Typical rather marked erosion of several ribs is noted. Electrocardio-

gram is essentially negative with exception of an unusually high T-wave in the second lead.

Comment: Coarctation of aorta is rare type of congenital lesion. Diagnosis is based on increase in tension in vessels of upper part of body. Characteristic development of collateral circulation is manifested by enlargement of smaller arteries about chest wall. Erosion of ribs as revealed by x-ray film is pathognomonic. Prognosis is usually good. There is, of course, danger of development of aneurysms in vessels of upper part of body and cerebrum. Development of subacute bacterial endocarditis is not uncommon in this type of lesion.

#### 2. Patent Interventricular Septum.

is now 12 years of age. She has been under observation at Clinic for past 7 years. Mother has known since early infancy that her child had "murmur in the heart." Past history negative. Patient has had measles, chicken-pox, German measles, and scarlet fever. No history of rheumatic disease. Always well, able to take part in school activities including regular gymnasium work and tap dancing.

Physical examination reveals well developed, well nourished, healthy looking girl of better than average mentality. No cyanosis or clubbing of fingers. Physical examination is negative with exception of heart. Indefinite systolic thrill is made out over body of heart in 3rd left interspace. A loud harsh prolonged murmur is heard best in 4th interspace just to left of sternum; murmur occupies entire heart cycle and replaces both sounds. Second pulmonic sound is accentuated. Murmur is transmitted over entire anterior chest and is heard through to back. Six foot x-ray film reveals heart normal in size and contour. Electrocardiogram is normal with exception of a high T-wave in first and second leads. Patient's sister has exactly same type of congenital heart defect and similar physical findings.

Comment: In uncomplicated patency of

interventricular septum opening is usually small and interferes slightly or not at all with cardiac function. Usually defect is manifested by loud prolonged murmur heard best in 3rd and 4th left interspaces. Thrill is felt in about one-third of cases. Intensity of murmur and thrill varies inversely with size of opening. Cyanosis is not present. X-ray usually shows normal heart and electrocardiogram is negative. These patients present no symptoms and are essentially normal individuals. The only danger in this type of lesion is development of subacute bacterial endocarditis at site of lesion.

### 3. Patent Interauricular Septum

is 13 years old. Has been under observation for one and one-half years. Diagnosis of heart disease was first made at two and one-half years of age. Patient has always been undersized and becomes easily dyspneic. Has never been cyanotic. Has had measles, mumps, pertussis, chicken-pox and possible poliomyelitis but gives no history of a rheumatic disease.

Physical examination: Patient is of delicate stature and is undersized for her age. Is quite dyspneic at rest. No cyanosis is noted and no definite clubbing of fingers although there is suggestive clubbing of thumbs. Examination of heart reveals a marked thrill in third interspace just to left of sternum. Over this area a harsh prolonged systolic murmur is heard. Murmur is well transmitted throughout entire chest and is heard over both humeri down to elbow and on top of skull. Second pulmonary sound is accentuated.

Six foot x-ray film reveals marked enlargement especially in region of right auricle and also involving both ventricles. There is also marked dilatation of pulmonary arch. No shadow of aorta to right of sternum. Vessels of lungs are enlarged and pulsating. Electrocardiogram shows no axis deviation but does reveal a moderately high P-wave.

Comment: Diagnosis is made (1) on characteristic undersized condition of patient indicating definite hypoplasia

of aorta due to arterial-venous shunt throwing a greater load on pulmonary circulation and less than normal load on aorta, (2) on thrill and murmur in 3rd left interspace, (3) absence of cyanosis, (4) rather typical x-ray picture indicating an enlargement especially of right auricle, right ventricle and pulmonary artery, and hypoplasia of aorta. Patients with patent interauricular septal defects and marked enlargement of heart have been known to live into the 5th and 6th decades. Large defects in septum may occur in absence of murmurs. In such instances, diagnosis is based on characteristic x-ray findings.

### 4. Patent Ductus Arteriosus

is seven years old. Has been under observation 2 years. Has had chicken-pox and measles. Attention was first called to heart during first school examination. No history of rheumatic infection.

Physical examination: Patient is slightly built and somewhat underweight. Good mentality. Skin is pale. No cyanosis or clubbing of fingers. Examination of heart reveals distinct thrill over 2nd interspace to left of sternum. Over this area a loud typical so-called "machinery or locomotive" murmur is heard. This murmur is heard through both systole and diastole but is variable in intensity. It may be called a "systolic-diastolic murmur." Murmur is transmitted across upper left anterior chest toward clavicle. Systolic phase of murmur is fairly well heard over apex and over entire left anterior chest. Second pulmonary sound is well heard. Blood pressure systolic 100, diastolic 60.

Six foot x-ray film reveals slight enlargement of heart involving both ventricles with moderate enlargement of pulmonary artery. On fluoroscopy pulmonary artery pulsates markedly and appears more dilated than on film. Electrocardiogram is negative showing no axis deviation.

Comment: Most patients with patent ductus arteriosus get into trouble in

early adulthood. There are a number of reports in literature of patients who have lived into 5th and 6th decades with no evidence of cardiac embarrassment. Most patients, however, either succumb to congestive heart failure or subacute bacterial endocarditis relatively early in life.

5. Pulmonary Stenosis with Closed Interventricular Septum

is now 15 years old.

Was first examined at Clinic at 6 years of age and has been under continuous observation. Her younger brother also has congenital heart disease. Heart disease was first diagnosed at 3 years. Cyanosis was first noted at about 4 years of age. No history of rheumatic disease. Has had measles, pertussis, scarlet fever, and chicken-pox.

Physical examination reveals well developed girl of good mentality. Moderate cyanosis of skin and mucous membranes. Blood vessels of sclera are congested. Moderate cyanosis and clubbing of fingers has progressed slowly during 9 years of observation. Examination of heart reveals marked thrill over pulmonic area. Over this area a harsh loud systolic murmur is heard. Murmur is transmitted throughout chest and is well heard down both humeri and over entire length of spine, but is only faintly heard in vessels of neck. Second pulmonic sound is faintly heard.

Six foot x-ray film reveals heart within normal limits as to size but contour is typical of so-called Coeur-en-Sabot characteristic of pulmonary stenosis. Change in contour of heart is due to enlargement of right ventricle which pushes left ventricle upward and backward producing so-called double apex. Pulmonary arc is not dilated and aorta is not pushed to right.

Electrocardiogram shows marked right preponderance.

Comment: This is case of pulmonary stenosis without patency of interventricular septum, is probably due to inflammatory intra-uterine lesion. Diagnosis is based on slowly progressive cyanosis,

characteristic thrill and murmur which is not well transmitted into vessels of neck, typical contour of heart and marked right preponderance in electrocardiogram. This lesion is to be distinguished from next case of Tetrad of Fallot. Prognosis is relatively good in this type of pulmonary stenosis.

6. Pulmonary Stenosis with Patent Interventricular Septum, Dextro-position of Aorta and Enlargement of Right Ventricle. (Tetrad of Fallot)

is 13 years old. Has been under observation for 4 years. Has been cyanotic from birth. Has always been dyspneic and is easily fatigued.

Physical examination reveals marked cyanosis of skin and mucous membranes. Eye grounds reveal typical engorged tortuous veins. Congenital defect of left iris. Clubbing of fingers and toes is extreme. Patient becomes easily dyspneic. Examination of heart reveals inconstant short thrill over 2nd left interspace; heart sounds are rapid and regular; over pulmonic area harsh murmur is heard; murmur is not unusually loud and is only fairly well transmitted into vessels of neck.

Six foot x-ray film reveals slight cardiac enlargement involving mostly right ventricle and auricle and producing moderate Coeur-en-Sabot. Shadow of aorta is to right and is easily seen to right of sternum. Electrocardiogram reveals marked right preponderance and a high peaked P-wave indicative of hypertrophied auricle.

Comment: This is the common type of cyanotic congenital cardiac lesion in patients living to early adult life. Diagnosis is based on history of cyanosis from birth, extreme cyanosis and clubbing, less intense murmur and thrill, typical contour of heart revealing a dextroposed aorta and enlargement of right heart and marked right preponderance and high P-wave in electrocardiogram. Prognosis in this type of lesion is less favorable than in pure pulmonary stenosis.

Summary:

Among children and young adults congenital heart disease accounts for 10 to 25 per cent of all cardiac disease. Great majority are not cyanotic and do not have clubbing of fingers. Many live out their normal expectancy with no evidence of cardiac embarrassment. Prognosis, however, is not good in cyanotic congenital heart disease. All patients with congenital heart disease are constantly in danger

of subacute bacterial endocarditis.

Diagnosis of congenital heart disease itself is insufficient; exact type of lesion can be determined in most instances. Differential diagnosis depends on complete cardio-vascular examination including, especially, x-ray, fluoroscopy and electrocardiography.

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### III. GOSSIP

St. Louis County is making effective use of a mobile unit in finding patients with tuberculosis according to Dr. G. A. Hedberg, Administrator of St. Louis County Tuberculosis Sanatorium at Nopeming. Richest harvest comes from the study of contacts and the follow-up of cases after discharge from an institution. Greatest interest value is developed by the mobile unit. This is tuberculosis week and marks the start of the annual campaign for the sale of Christmas seals. Annual dinner of the Minnesota Public Health Association will be held at the Nicollet Hotel, Friday, October 7, 6:30 P.M. Featured speaker will be Dr. Walter H. Judd of Nebraska, China, Minneapolis, and Washington....

..This week I spoke on the radio on "Job Opportunities in the Hospital Field." Our skilled and partially skilled workers represent a unique social class, in that humanitarian motives and institutional loyalty are greater than in the same type of persons employed in other situations. Our men and women give loyal and faithful service through the years because they like to care for the sick. Hospitals will have no reconversion problem in the post-war era. Whether times are good or bad, hospitals must care for the sick. Wages at the present are the highest in history. The higher wages of industrial employment are met in the hospital field by permanence of position, and greater job satisfaction....M. J. Shapiro who is our speaker today knows more about the hearts of our school children and our young adults than any other physician in this community. He has been identified with our school system and community heart center from the beginning. He feels that physicians often fail to appreciate the importance of heart disease in general and rheumatic infection in particular as a cause of disability and thwarted careers in young people. In season and out of season he works for heart cripples and is at present interested in the move to develop Motley School into a community heart center. The last issue of the Journal of the American Medical Association (October 14, 1944) contains an interesting series on this subject. It is good that men like Dr. Shapiro exert mission-

ary zeal in their efforts to help disabled or potentially disabled individuals from heart disease....There will be a special course for nurse anesthetists at the Center for Continuation Study, November 16, 17, 18. Faculty will include Joseph W. Baird, Clinical Associate Professor of Anesthesiology, Raymond N. Bieter, Professor of Pharmacology, Ralph T. Knight, Clinical Professor of Anesthesiology, A. William Friend, Clinical Assistant Professor of Anesthesiology, Frank H. Cole, Instructor in Anesthesiology, all of the medical school. Charles R. Adams, Instructor in Anesthesia, Mayo Foundation, Stuart C. Cullen, Assistant Professor of Anesthesiology, State University of Iowa, and their associates. Anesthesiology is our most rapidly growing department. Nurse anesthetists extend the service of medical anesthetists just as medical technologists extend the services of clinical pathologists. Developments in anesthesia have been rapid and successful.....War-time Graduate Medical Meetings are now being conducted at Schick General Hospital, Clinton, Iowa, Fort Snelling, Minneapolis, Fort Des Moines Station Hospital, Des Moines, Iowa. Program is held at each station every two weeks, and consists of a ward walk or demonstration, lecture or lectures and a round table discussion. Staff members from the Medical School, Mayo Foundation, Iowa State University and other medical centers participate. Civilian physicians are invited to all sessions, and attendance by the non-military is large in some installations. Speakers during September and October included Paul A. O'Leary, John S. Lundy, Fred M. Smith, Frank H. Krusen, Lt. Col. Baldwin Lucke, Thomas J. Kinsella, F. E. B. Foley, Raymond N. Bieter, Harold N. Wright, Henry E. Michelson, and others.....Post-war plans for Minnesota include development of Public Health units in Minnesota. Movement of people from cities to the suburbs has created a difficult administrative problem. Population of Hennepin County (outside Minneapolis) has now grown to a size which would accommodate two full-time units consisting of health officer, sanitary engineer, public health nurses, and record clerks.....