INCIDENCE AND AETIOLOGICAL CLASSIFICATION OF SYSTOLIC MURMUR IN FIFTY ASYMPTOMATIC CHILDREN.

THESIS

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for the master degree in cardialogy.

BY

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بسم الله الرحمن الرحيم

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AIM OF THE WORK

Evaluation of a systolic murmur is one of the most commone tasks which confronts the physican who is conducting a physical examination especially with an asymptomatic child.

Misinterpretation of innocent murmur may lead to anxiety on the part of both the physican and the patient & his family; through a prolonged period of unnecessary restriction of physical activity and perhaps to cardiac neurosis.

In the past, errors in diagnosis have led to exclusion of healthy people from athletic activities, flying and military service.

The proper interpretation of such murmur is especially important in children with regard to the necessity of use of prophylactic pencillin for rheumatic fever and bacterial endo-carditis.

On the other hand and after using many recent techniques e.g. phonocardiography and Echocardiography also with the helpfull aid of cardiac catheterization many cases proved to be organic in origin e.g. mild pulmonary stenosis, ventricular septal defect, Aortic stenosis, or subaortic muscular hypertrophy.

Then as systolic murmur in an asymptomatic child may be compatible with perfect health or it may indicate organic heart disease; our aim in this work is to detect the aetiological causes of systolic murmurs discovered on routine medical examination in young children- at school age- and to identify the correct way to settle the proper diagnosis in a case like that.

REVIEW OF LITRATURE

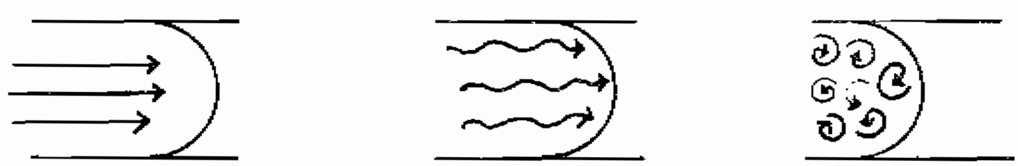
× The Probable Mechanism of the Production of Murmurs:

Turbulance Theory

For many years the most widely accepted theory of the cause of murmurs was that due to turbulance in the blood flow. This was based on the work of Osborne Reynolds, who described fluid flow as a function of the velocity, tube diameter and viscosity- a concept which would indicate the development of turbulant flow from previously Laminar flow. If the resultant value (termed by Reynold's number) exceeded 2000, turbulance was present (1)

$$R = \frac{D \times U}{V} \geqslant 2000 \longrightarrow \text{Turbulance} \longrightarrow \text{Noise}$$

R = 200 600 2000



(Fig. 1)

× The derivation of the Reynolds number (R) is shown where(D) is the diameter of the channel,(U)is the free stream velocity and (V) is the kinematic viscosity.
The change from laminar flow through the transitional zone to fully turbulant flow is shown.
In this the fluid particles move randomly in diraction and velocity.
Once turbulant, the flow does not become more randome or turbulant(1)

Because the Reynolds number of blood being pulsed through a stenosis that produced a murmur wasgreater than 2000,It was assumed that the development of turbulence producede the noise.

This theory was also applicable to conditions in which there was no stenosis such as anaemia or high cardiac output states and this constituted a strong reason for it's widespread acceptance.

There is, however good reason for doubting that turbulence is a cause of murmurs. Recent discoveries in the field of aerodynamic sound have indicated that turbulance is an ineffecient generator of noise at low velocities of flow.(2)

It becomes an effecient generator of sound, however, if the velocity of flow approaches the speed of sound in the medium. A good example is the noise produced by jet engines. This is radiated a great distance from it's source but one must rialize that the velocity of air flow equals or exceeds the Mach number.

When one realizes that the speed of sound in the blood is of the order of 150.000 m/second it is difficult to accept turbulence as a cause of murmurs: since velocities of flow of this magnitude are never approached.(3)

If the observer moves closer to the source of turbulance then it is true that appreciable noise is generated at lower velocities, however, even within a distance of one wave-length there would be no significant sound caused by turbulance unless the velocities exceed what we know to exist in the cardiovascular system.

Turbulance may also be rejected as a cause of murmurs on the basis of MacDonald's finding that the critical Reynolds number of pulsating blood in the aorta and great vessels is as law as 1000 (4)

As the velocity of ejection through a normal vàlve produces a Reynolds number greater than 1000 throughout most of the duration of the systole then one can reasonably expect all of us to manifest pansystolic murmur.

Another reason for the weakness of the turbulance theory of murmurs relates to the defenit pitch or frequency that certain murmurs manifést. (1)

It has been shown that noise due to turbulance has a very broad frequency spectrum and if murmurs were due to this, then they would be essentially of all the same pitch.

Cavitation Theory:

It is well known that when a liquid is forced through an orific at a velocity sufficient to cause a local pressure drop below the vapour pressure of the liquid, bubbles are very rapidly formed and collapses as they move down-stream, producing an intense crackling noise. The frequency of this type of noise in general is higher than what we know to exist in the cardiovascular system and it is radiated a great distance from its source.

In a long series of experiments using both steady and pulsatile flow with appropriate modles, we were able to produce cavitation in blood, But it was found that the driving pressure required to force blood through the narrow orifice which would produce this phenomenon was greater than 350 mmHg for these reasons cavitation theory can not be accepted as a cause of murmurs such as are detected and interpreted clinically.(5).

Vortex Sheeding Theory:

It is known that when an obstacle is present in the path of any fluid, vortices are shed along its edge. If the obstacle is a smooth wire or cylinder, a clear tone is produced Fig.3 (6).

The sound produced by type of flow is described as an Aeolian tone. In this particular type of flow, the pressure oscillation associated with vortex shedding are significantly greater than those experienced with turbulence.. In this particular type of flow, the pressure oscillation of acoustical frequency are of the order of 2 to 8 mm Hg. The fact that 1 mm Hg represents may dynes per cm^2 of acoustical energy makes it easier to accept this more effecient form of fluid flow as a cause of murmurs. (1)

It should be mentioned that these pressure oscillations are generated in the fluid itself. A resonant vibration of the obstacle or the vessel wall is not required for oscillations significant intensity to be generated.

This is emphasized because several investigators have sought to explain murmurs as being due to the vibration of a vessel wall or a valve (7)

Several characteristics of this type of flow are worthy of description. In the simplest form of vortex sheeding, that is, in the production of an Aeolian tone- vortices are shed on either side of the cylinder.On listening perpondicular to the flow,a lift oscillation is found to occur with the sheuding of two vortices. However if one listens parrallel to the flow a dr-ag oscillation occurs with the shedding of each vortox.

In general, the amplitude of the drag oscillation is one ninth the strength of that of the lift oscillation. (1).

In other words, the frequency and strength of the sound perceived is dependant in part upon the position of the listener in relation to the flow.

Another characteristic of vortex shedding flows is that the frequency of the noise so produced increases in direct proportion to the velocity. A linear relationship has been described by **str-ouhal** and has been reconfirmed many times. (1)

On the basis of the theoretical considerations shown in the figure (4) one would expect a slight stenosis to produce a relatively high frequency murmur a more severe stenosis one of lower frequency , and a maximal stenosis a murmur which is once again high in frequency.

Fig. (2)

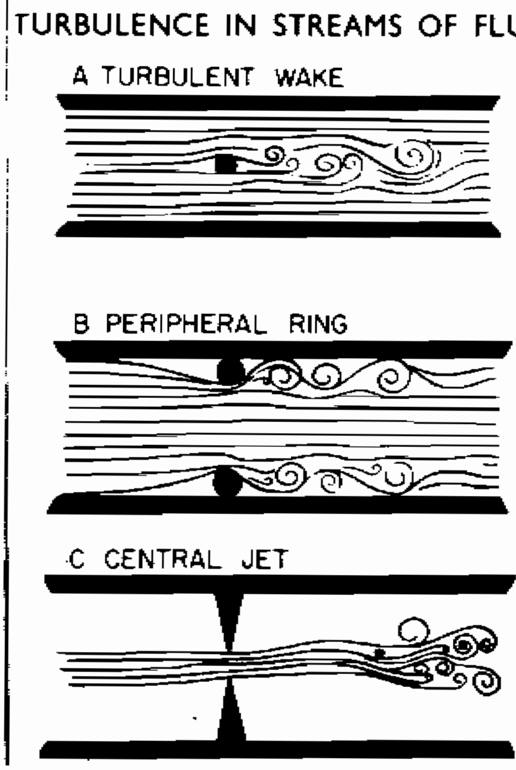


Fig. (3) A cylindrical obstruction in a stream of fluid causes eddy currents downstream which may produce sounds corresponding to Aeolin tones vibrations of similar origin may be produced by circular obstruction around the periphery of a pipe. A smaller orific produces central jet.

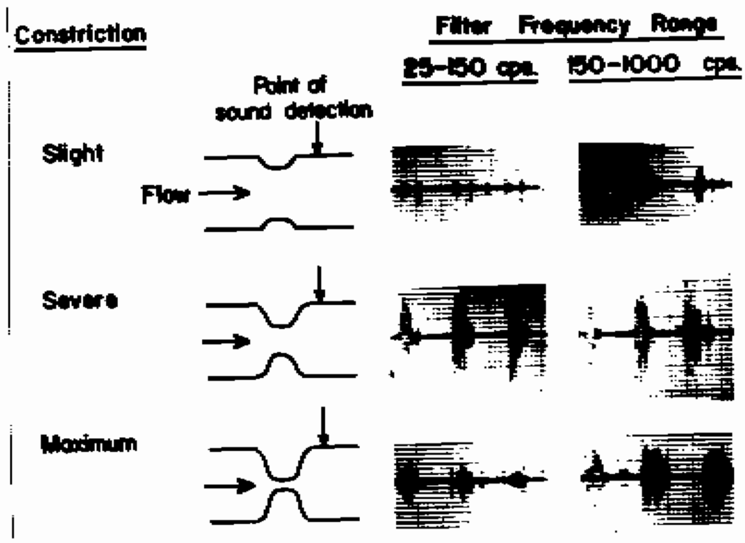


Fig. (4) The changing contribution of high frequency component of the murmur produced by increasing constriction of a dog's ascending aorta.

The Elema phonocardiagraphy was used to discriminate the relative intensities of high and lew frequencies. (From Amer.J. Mex. 27:360,1959).