1. EVALUATION AND MANAGEMENT PRIOR TO CATHETERIZATION

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For the last three decades, improvements in the diagnosis and management of congenital heart disease have resulted in some of the most astounding survival increases in all of medical science. Despite this progress, deciding whether to catheterize a particular child remains a difficult, uneven, and poorly predictable event. Testimony to the difficulty of this decision is provided by a recent study by Kreutzer et al. Using administrative data bases from several states, and assuming that the indications for surgery are roughly equivalent across multiple centers, the frequency of catheterizations per open heart surgeries varies enormously (Fig. 1-1).

![Chart showing variability in rates of diagnostic cardiac catheterizations per surgical repair for ventricular septal defect among institutions from 9 states in 1992 (data obtained from analysis of hospital discharge administrative data).](image)

**Figure 1-1:** Bar graph demonstrates variability in rates of diagnostic cardiac catheterizations per surgical repair for ventricular septal defect among institutions from 9 states in 1992 (data obtained from analysis of hospital discharge administrative data).

The precise sources of this variability are not known, and understanding it would undoubtedly improve clinical decision making and resource allocation decisions. Nonetheless, several factors are likely responsible, at least in part, for this marked variability in the utilization of cardiac catheterization.

**THE MEDICAL AND PSYCHOLOGICAL RISKS OF CARDIAC CATHETERIZATION.**

Efforts to reduce the risks and pain of cardiac catheterization, including improved catheter tools, contrast agents, imaging systems, and limitations on credentialing of cardiologists to perform catheterizations, have succeeded. The mortality rate for diagnostic cardiac catheterizations has fallen as has the complication rate, even for patients thought to be at the highest risk (i.e. neonates and patients with
primary pulmonary hypertension). Thus, a low risk procedure that may improve management will be utilized more frequently.

**THE ACCURACY OF NON-INVASIVE TESTING.**

Improved echocardiographic and magnetic resonance imaging techniques significantly reduce the need for cardiac catheterization and run counter to improvements in catheterization results. This simple relation was first described by McCartney et al (Fig. 1-2), and helps explain some of the variability.

*Figure 1-2: The decision of whether or not to catheterize an infant with coarctation of the aorta depends on the risks of the catheterization and the accuracy of the non-invasive testing. (Printed from McCartney et al., Br. Heart J. 51:330, 1984).*

**THE SUCCESS OF MANAGEMENT OF THE DISEASE IN QUESTION.**

If medical or surgical management is almost always successful (e.g., the silent PDA, or arterial switch for simple TGA), improving diagnostic accuracy seems a bit superfluous. On the other hand, catheterization may very well be justified in very dangerous conditions (e.g., primary pulmonary hypertension or HLHS s/p Stage 1) even when the results of catheterization are often of limited value.

**THE ECONOMIC COSTS OF CATHETERIZATION.**

Among the most frequently lamented influences on medical decision-making is the impact of financial considerations on the consumption of medical care. Such considerations will have more of an impact on procedures such as cardiac catheterization in congenital heart disease, where the medical indications are changing rapidly and are ill-defined. Some economic forces serve to artificially increase cath lab utilization (hospital profitability, professional reimbursements), while others (capitated care, insurance disallowances) artificially reduce it. A healthy, reasonable and balanced alignment of financial incentives has yet to come to the management of congenital heart disease. Until it does, giving the proper weight to financial considerations depends primarily on the integrity and wisdom of the physicians involved.

Ten years ago, we described the decision-making process of whom to catheterize as a series of "collaborative, floating, ad hoc decisions by clinical cardiologists, surgeons, ultrasonographers, radiologists and catheterizing cardiologists". That process hasn’t changed, but the results have: there are, in general, fewer diagnostic catheterizations and more frequent interventional studies (Fig. 1-3).