

The Need for Nursing Education in the Care of Adults With Congenital Heart Defects

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abstract

Background: The population of adults with congenital heart defects is rapidly expanding. Formal and informal nursing education offers little if any training in the care of adults with congenital heart defects, creating a disparity between the growing need for care for these patients and the availability of knowledgeable providers.

Methods: A needs assessment survey was conducted to assess educational needs, use of available resources, and learning method preferences of nurses within a Midwestern community hospital ($N = 800$). The convenience sample included 269 responses ($n = 269$). A pilot survey was conducted with a subset of the population ($n = 18$).

Results: The results showed a poor understanding of adults with congenital heart defects, with findings similar to those of previous studies.

Conclusion: Providing education may help to prepare nurses to care for adults with congenital heart defects as these patients are seen in increasing numbers in all areas of health care.

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Congenital heart defects are the most common of all congenital defects. Adults with congenital heart defects now outnumber children with this condition because more than 90% of these patients survive to adulthood (Meijboom & Mulder, 2010). Until recently, adults with congenital heart defects were cared for exclusively by pediatric specialists in specialty centers (Saidi & Kovacs, 2009). The current trend is to transition patients into more developmentally appropriate adult

care. Smooth transitions into adult cardiology are essential to prevent complications and lapses in care (Webb, 2011). Lapses in care are very common in adults with congenital heart defects and are associated with higher mortality rates, serious complications, and increased need for emergency care (Gurvitz et al., 2007). Lapses in care occur most frequently during transition, and some studies showed that admissions to community hospitals doubled during this phase (Gurvitz et al., 2007; Verheugt et al., 2010a, 2010b).

Adults with congenital heart defects are presenting to community hospitals in increasing numbers, but there has been no additional education or training for nurses who are expected to care for these patients (Verheugt et al., 2010a; Webb, 2011). This study evaluated the knowledge and comfort level of the nurses in a Midwestern community hospital in caring for adults with congenital heart defects. The assumptions that fueled this investigation were that most nurses in the general hospital setting are not familiar with congenital heart defects or comfortable caring for adults with this condition and that providing education could potentially improve outcomes for this patient population. In addition, the study

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instrument asked respondents about the resources that they use to answer clinical questions or solve problems as well as to determine their preferred method of learning. The data were then used to help to develop an educational program.

TRANSITION AND TRANSITION THEORY

Transition theory, cited frequently in the nursing literature, was developed by Meleis (2010). The premise of transition theory is that a major role of nurses is to prepare and guide patients through developmental, situational, and health/illness-related changes to help ensure positive outcomes (Meleis, 2010). Nurses assist with transitions by gaining an understanding of the process, the individual, and the goals to be met, as well as barriers and facilitators to achieving the goals. Assisting and guiding individuals through these obstacles is the nursing profession's forte.

Lugasi, Achille, and Stevenson (2011) used transition theory as the framework for a meta-summary of factors that facilitate the transition to adult-centered care. Adults with congenital heart defects have identified the most significant barrier to transition as lack of comfort or trust on the part of patients because of the well-known lack of knowledge about congenital heart defects among most health care workers in community hospitals (Koh, Yap, & Le Tan, 2011; Moons & Meijboom, 2010). Formal education and familiarity with this patient population have been postulated to improve the transition process, patient satisfaction, and overall outcomes (Koh et al., 2011).

The transition from adolescence to young adulthood and other major transitions are especially difficult for patients with chronic illness or congenital defects (Canobbio & Higgins, 2004; Jalkut & Allen, 2009). Many of these patients who have survived to adulthood begin to have increasing limitations, serious dysrhythmias, congestive heart failure, and exacerbations (or development) of other significant problems as a result of the congenital defect (Loyola University Health System, 2008). These limitations and problems make continued follow-up care essential.

Landzberg et al. (2001) stated that more than 9,000 adults with congenital heart defects reach age 18 years annually, in the United States alone, placing a logistical strain on the small number of adequately trained pediatric or adult cardiology specialists (Child et al., 2001). This growing population has fostered a movement to transition these young adults away from the care of pediatric congenital heart defect specialists to the care of general cardiologists and primary care providers, occasionally in partnership with the congenital heart defect specialist (Child et al., 2001; Landzberg et al., 2001).

Transition is not simply a transfer of medical care. It is a purposeful, planned movement of adolescents and young adults with chronic physical and medical conditions from child-centered (parent) to adult-centered (self) care (Hudsmith & Thorne, 2007; Saidi & Kovacs, 2009). Transition is much more complex than transfer, and it involves many interrelated issues and support systems (Davies, 2005).

Smooth transitions into adult cardiology care for adults with congenital heart defects are essential to prevent patients from being "lost to follow-up" and receiving no care at all (Dearani, Connolly, Martinez, Fontanet, & Webb, 2007). Lapses in care among this population are very common, and many patients with lapses in care of 2 years or longer were found to be much more likely than patients with consistent care to have serious symptoms and new diagnoses, and to require emergency care (Gurvitz et al., 2007; Yeung, Kay, Roosevelt, Brandon, & Yetman, 2008).

Gurvitz et al. (2007) found that admissions to the hospital through the emergency department doubled during the transition period. Most of these admissions were to hospitals that averaged fewer than five congenital heart surgeries per year. In addition, these patients are more likely than the general population to seek urgent medical care, frequently in the emergency department (Cross & Santucci, 2006).

LITERATURE REVIEW

Very little nursing-based research has addressed the topic of adults with congenital heart defects. Only one study (Moons et al., 2009) was identified that addressed the knowledge base or educational needs of nurses caring for adults with congenital heart defects. The literature search found numerous articles on transitioning these patients to adult care, but there is very little evidence of education or training for nurses (Lugasi et al., 2011). For this population, care in community hospitals has become much more prevalent, and nurses will be increasingly called on to care for adults with congenital heart defects (Lugasi et al., 2011; Verheugt et al., 2010a, 2010b).

Current guidelines from the American College of Cardiology and the American Heart Association Task Force recommend a coordinated, organized transition process for patients with congenital heart defects, led by advanced practice nurses (Warnes et al., 2008). Inadequate transition services may lead to lapses in care, increasing the likelihood of complications, including heart failure and dysrhythmias that can lead to premature death and disability (Warnes et al., 2008; Yeung et al., 2008).

Successful transition to adult cardiology care is dependent on the guidance of advanced practice nurses (Jalkut & Allen, 2009; Sable et al., 2011). Much of the current literature indicates that nurse specialists are essential to the success of any program for adults with congenital heart defects (Saidi & Kovacs, 2009). Ensuring optimal transitional experiences has been shown to improve long-term follow-up, decrease and prevent complications, and reduce the number of patients lost to follow-up (Verheugt et al., 2010a, 2010b; Webb, 2011; Yeung et al., 2008).

Adults with congenital heart defects have a significantly greater need for primary, emergency, and acute care than the general population. Hospitalization rates for this group are two to three times higher than the rate for the general population, and the emergencies that these patients experience have a high inpatient and 3-year mortality rate (Kaemmerer et al., 2008; Verheugt et al., 2010a, 2010b).

Education and Training

Care of adults with congenital heart defects is not a part of most general or emergency medicine training, creating a mismatch between the growing need for emergency (and acute) care for these patients and the training that is typically provided (Cross & Santucci, 2006). This mismatch indicates a need for better education and training in the care of adults with congenital heart defects (Saidi & Kovacs, 2009).

Many nurses and physicians do not feel adequately prepared to care for adults with congenital heart defects (Gurvitz et al., 2007). One study looked at the knowledge base of cardiac nurses and specialized nurses who care for adults with congenital heart defects and found the level of understanding to be low for both groups (Moons et al., 2009). Education about congenital heart defects and the care of adults with this condition is a very low priority in medical and nursing education, creating a disparity between the growing need for care for these patients and the training that is typically provided (Moons et al., 2009).

Most nurses who work with adults with congenital heart defects have learned independently or through on-the-job training (Moons et al., 2009). The lack of formal education for nurses and the current low level of nurses' knowledge about these patients have been identified as among the top five challenges for the next decade by the International Adult Congenital Heart Disease Nursing Network (Moons et al., 2006, 2009).

Educational recommendations for advanced practice nurses who care for adults with congenital heart defects have been published (Child et al., 2001; Silversides et al.,

2010; Warnes et al., 2008). However, few resources have been developed to allow nurses to achieve these goals. The literature review confirmed the presence of an expanding population that uses high levels of health care resources, especially emergency services in community hospitals, without a corresponding educational initiative to prepare nurses to care for these patients (Mackie, Pilote, Ionescu-Ittu, & Marelli, 2007; Sieswerda & Mulder, 2010; Verheugt, 2010a).

Gaps in the Literature

The most glaring gap in the literature is the lack of research on the need for nursing education in congenital heart defects and the care of adults with this condition. The current literature emphasizes the role of the advanced practice nurse as essential to success, but concern for education and training is focused almost entirely on physicians.

METHODS

This study reflects an attempt to address the educational needs of nurses caring for adults with congenital heart defects within a Midwestern community hospital. Transition theory was employed to guide the research, which included a needs assessment survey. This survey was designed to gain an understanding of the gaps in nurses' knowledge about adults with congenital heart defects, the current level of nurses' comfort in caring for these patients, and the method of educational presentation that is considered most effective. The survey findings were then used to help to design educational offerings based on the identified needs.

Research Design

This project consisted of a qualitative, cross-sectional, noninterventive needs assessment survey to identify nurses' understanding of adults with congenital heart defects and to develop an educational program to address the identified knowledge gaps. Several resources were used to develop survey questions to obtain the information needed. The survey was written using a closed question type format to minimize bias (Bice-Stevens, 2001; Fink, 2008; Grant, 2002; Merriam, Caffarella, & Baumgartner, 2007; Polit & Beck, 2008).

The survey consisted of 15 multiple-choice, single-answer questions. The first five questions involved demographic information: population served, area or department of practice, number of years working as a nurse, exposure to patients with cardiac conditions, and exposure to patients with congenital heart defects. Question 6 presented a patient scenario that involved trauma and asked how comfortable the nurse would be

caring for this patient. Question 7 added a congenital heart defect to the trauma scenario and then asked again about the participant's comfort level. Questions 8 to 11 asked very simple questions to address the participant's current knowledge about congenital heart defects and adults with congenital heart defects. Questions 12 to 15 addressed the adequacy of available resources, the most common resources used, opinions on whether education on congenital heart defects and adults with this condition would be helpful, and the preferred method of learning.

A small pilot survey was designed and implemented to identify problems with the survey and determine the feasibility of the final survey. After the pilot survey was reviewed, appropriate changes were made to the final survey.

Population and Sample

The population included all registered nurses employed by the sponsoring Midwestern hospital system. According to organizational staffing records, the number of nurses employed at all locations was 800.

Sample Size

The sample size that was needed was calculated with the statistical formula for sample size of a finite population. This calculation showed that a sample of 260 would provide a 95% confidence level and a 1.4 confidence interval, indicating that a sample of this size would have a 95% chance of being representative of the population.

Protection of Human Subjects

The details of this study were formally submitted to the institutional review board of the sponsoring hospital, via the corporate office. The study was determined to be exempt from the need for approval because there were minimal if any risks to human subjects.

Pilot Survey

The pilot survey was distributed electronically to an anonymous population subset of 25. The number of responses to the pilot survey was 18, or 72%. The pilot survey results were reviewed, and changes and clarifications were made to the final survey.

Sampling Procedures

A convenience sample was obtained by distributing surveys to nurses, who were identified only by work area or department on the hospital's e-mail directory. Participants submitted the completed surveys anonymously to an online site. A follow-up reminder e-mail was sent to all participants who received the first e-mail to remind them to complete and return the survey.

Definitions

Congenital heart disease—An actual or potential abnormality of the heart and great vessels that is present at birth and poses actual or potential problems (National Institutes of Health, National Heart, Lung, and Blood Institute, 2012).

Adult congenital heart disease—A congenital heart defect in a patient who has survived to adulthood (American Heart Association, 2012).

Learning Link—An online method of providing staff education.

QUICK Notes—An online information source that provides a printable brief synopsis, important facts, and considerations for patient care and management.

RESULTS

This research project was based on the assumption that most nurses within community hospitals are not familiar with adult congenital heart disease or comfortable caring for patients with this condition. In addition, it was believed that providing education could potentially improve outcomes for this patient population.

Survey Results

Eight hundred requests for participation in the survey were sent out, and 269 responses (completed surveys) were received. The number of returned surveys (269) was greater than the calculated sample number needed (260), indicating a greater than 95% certainty that the sample was representative of the population. Samples that are representative of the population increase the accuracy of measurement and improve the validity of the survey findings (Mora, 2011).

Fifty-two percent of the participants worked on monitored units, including the intensive care unit and the emergency department (Table 1 [available as supplemental material in the online version of the article] and Table 2). A frequency distribution of the number of years of experience as a nurse was bimodal, with 27% of participants having 0 to 5 years of experience and 20% having more than 25 years of experience. Sixty-eight percent of the participants indicated that they saw patients with cardiovascular diagnoses daily, but only 6% saw adults with congenital heart defects on a daily basis.

Eighteen percent of respondents were definitely comfortable caring for the patient with trauma who was described in the survey, but this number dropped to 9% when it was noted, in the next question, that this patient had a congenital heart defect. Only 50% of respondents were able to identify the most common congenital heart defect, and 40% of respondents were able to identify the most common complication that affects adults with

congenital heart defects. Seventy-eight percent of participants either reported that resources were inadequate or stated that they were “not sure.” The most commonly reported information resources used were “coworkers or supervisors.” Eighty-seven percent of participants responded that education on this topic would likely or definitely be beneficial. The overall preference of learning mode was for online education, either alone or in combination with another mode.

Data Analysis

The descriptive data obtained via the survey can be generalized to the population because the actual sample size exceeded the calculated size needed to be representative of the population (Polit & Beck, 2008; Sheehan, 2001). Evaluation of the responses showed that the knowledge base on adults with congenital heart defects is limited, resources are inadequate, and 91% of respondents either are not at all comfortable caring for adults with congenital heart defects or are not comfortable in this role unless they have experienced help and readily available resources. Only 9% of participants reported feeling comfortable caring for these patients without substantial guidance. Most participants preferred online education, but more traditional learning modes were also identified. To help address these preferences and provide coverage of the content, 12 QUIK Notes were developed. QUIK Notes are an educational resource that can be accessed online or printed for independent study (Appendix, available as supplemental material in the online version of the article). QUIK Notes covered 12 of the most common congenital heart defects and additional general concepts concerning the care of these patients.

The demographic findings and analysis of responses on the pilot survey were similar to those obtained on the final survey (Table 2). The survey questions showed face validity because they seemed to be reasonable questions to obtain the information needed (Mora, 2011).

Implementation of Findings

The results of the survey were reviewed to establish congruence with the initial assumption and survey objectives. Organizational guidelines were reviewed and a process design was developed for an online introductory course using concepts and methods of online education (Merriam et al., 2007; Moore & Kearsley, 2005). The online course included basic objectives, interactive components, and the opportunity to learn more if the learner desires. The online education was designed to allow future additions and branching programs to build on the introductory presentation.

TABLE 2
COMPARISON OF PILOT SURVEY AND FINAL SURVEY RESULTS

Characteristic	Pilot Survey	Final Survey
Sample size	<i>N</i> = 18	<i>N</i> = 269
Response rate	72.0%	33.6%
0 to 5 years of experience	39%	27%
> 25 years of experience	11%	20%
Monitored work area	52%	69%
Patients with cardiovascular diagnoses seen daily	67%	68%
Patients with congenital heart defects seen daily	6%	6%
General knowledge	52%	60%
Comfortable caring for adults with congenital heart defects	8%	9%
Inadequate resources	94%	78%

The content was then sent to the information technology department for review, modification, and animation. After approval was obtained, the course was uploaded to the Learning Link and activated. Information about the course was disseminated via e-mail announcements that included time frames for completion.

The plans for sustainability of the course include initiating systemwide use and ongoing evaluation. Future plans include additional online courses presenting increasingly complex detail on adults with congenital heart defects as a voluntary activity and formal testing of the pre- and posttest items. The initial group of 103 participants completed the online education, including the pre- and posttests. The mean score on the pretests was 70%, and the mean score on the posttests was 95%.

DISCUSSION

The survey results supported the assumption that most of the nurses in the study hospital are not comfortable caring for this population, as evidenced by a decrease from 18% to 9% of respondents who reported feeling comfortable providing care after learning that the patient had a congenital heart defect. Evaluation of the survey results on knowledge of adults with congenital heart defects indicated that this discomfort may be related to a lack of understanding of the population because fewer than half of respondents were able to identify the most common congenital heart defect or the most common complication of adults with congenital heart defects.

key points

Adults With Congenital Heart Defects

Lawler, B. A. (2013). *The Need for Nursing Education in the Care of Adults With Congenital Heart Defects*. *The Journal of Continuing Education in Nursing*, 44(2), 81-88.

- 1 Adults with congenital heart defects now outnumber children because of advances in medical science.
- 2 These adults are being transitioned away from pediatric specialists and specialty centers and are presenting to community hospitals in increasing numbers.
- 3 There has been little, if any, preparation of nurses to care for this growing population with unique health care needs.

The findings of this study showed a gap in nursing knowledge about a population that is becoming increasingly prevalent. This knowledge gap is a concern that has also been identified internationally as one of the top five challenges for the next decade in the care of adults with congenital heart defects (Moons et al., 2006, 2009). As this population has grown and the provision of care has decentralized outside specialty facilities, minimal education has been provided to nurses (Moons & Meijboom, 2010).

The findings showed a knowledge deficit that is consistent with findings of the pilot survey and previous research by Moons et al. (2009). These findings support the need for nursing education in the care of adults with congenital heart defects.

International recommendations for the management of adults with congenital heart defects include the employment of nurse specialists who are trained and educated in providing care for this patient population (British Cardiac Society Working Party, 2002). Much of the literature indicates that nurse specialists are essential to the success of any program for adults with congenital heart defects (Moons & Meijboom, 2010). There have been few educational opportunities for nurses in the field of adults with congenital heart defects; most nurse specialists who work with this population have learned on the job or have sought out education directed toward physicians (Moons et al., 2009).

Survey responses indicated that most nurses use coworkers as a source of information and problem solving (Table 1, available as supplemental material in the online version of the article). In most cases, this is appropriate; however, in the case of adults with congenital heart defects, coworkers in general hospitals may have insuff-

icient knowledge concerning these patients. The majority of respondents also noted that available clinical resources were inadequate. The overall preferred method of education was online delivery. Collected data were reviewed and findings were used to create and implement an online education program on adults with congenital heart defects.

Strengths of this study included the better than average response rate for online surveys and findings that were consistent with previous research and the pilot survey (Moons et al., 2009; Sheehan, 2001). The response rate of 33% improves the likelihood that the data are representative of the population and adds credibility to the findings (Sheehan, 2001). External validity, or the extent to which the results can be generalized to the population, was supported by the large response rate that is representative of the population (Mora, 2011; Polit & Beck, 2008). Reliability, or the degree to which the survey elicits the same type of information when used under the same conditions, was supported by the similarities between the pilot survey and the final survey.

Limitations of this study include the use of a convenience sample, nonrandomization, and data derived from self-reporting, which may be subject to the Hawthorne effect or related biases. The survey tool was created for this study and has not been formally tested for validity and reliability.

CONCLUSION

Advanced practice nurses have played a pivotal role in the collaborative care of adults with congenital heart defects, primarily through self-education (Moons et al., 2009). The data obtained and the review of the literature showed gaps in the knowledge level, education, and training of nurses who provide care for adults with congenital heart defects. For nurses to care for these patients successfully, the current gap in nursing knowledge must be addressed.

Future projects on this topic include working toward systemwide initiation of this education project and continual reevaluation and content building onto the course shell. Further research is needed on the promotion of nursing education in the care of adults with congenital heart defects and the development of formal education for nurses who specialize in this field. This study was undertaken first to evaluate the understanding of adults with congenital heart defects by nurses within a general hospital and then to enhance that understanding through an educational activity. The results of the survey were used to design an educational offering to meet the identified needs. In addition, to aid in understanding the care of adults with congenital heart

defects, QUIK Notes were developed on some of the most common principles of congenital heart defects and general principles of care for adults with this condition to be used as a resource at the point of care (Appendix, available as supplemental material in the online version of the article).

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Table 1. Survey Responses

1. Population		2. Department		3. Experience	
Pediatrics	18 - 7%	IP med/surg	52 - 19%	0-5 years as nurse	72 - 27%
Adolescents	1 - 0	OP med/surg	3 - 1%	5-10	50 - 19%
Adults	167 - 62%	I/O Surgery	16 - 6%	10-15	38 - 14%
Geriatrics	41 - 15%	PACU	9 - 3%	15-20	23 - 9%
All ages	42 - 16%	OR	16 - 6%	20-25	31 - 12%
		Telemetry	28 - 10%	>25	55 - 20%
		ICU	33 - 12%		
		Cath/Vascular Lab	5 - 2%		
		Geriatrics	6 - 2%		
		Women's Health	8 - 3%		
		NICU	12 - 4%		
		ED	30 - 11%		
		Urgent Care	2 - 1%		
		Behavioral Health	16 - 6%		
		Interventional Rad	2 - 1%		
		Endoscopy	5 - 2%		
		Specialty Clinic	7 - 3%		
		Other	19 - 7%		
4. Frequency of CV pts.		5. Frequency of CHD pts		6. Comfort caring for Trauma patient	
Never	2 - 1%	Never	30 - 11%	Definitely not	30 - 11%
Rarely (0-1/mo)	14 - 5%	Rarely (0-1/mo)	124 - 46%	No but would help	67 - 25%
Occ (1-4/mo)	16 - 6%	Occ (1-4/mo)	61 - 23%	Maybe with help	80 - 30%
Freq (5-15/mo)	55 - 20%	Freq (5-15/mo)	39 - 14%	Yes with resources	44 - 16%
Daily	182 - 68%	Daily	15 - 6%	Definitely	48 - 18%
7. Trauma & CHD?		8. CHDs are the most common CDs?		9. Most common CHD?	
Definitely not	40 - 15%			ASD	134 - 50%
No but would help	83 - 31%	True	215 - 80%	VSD	93 - 35%
Maybe with help	78 - 29%	False	54 - 20%	BAV	22 - 8%
Yes with resources	45 - 17%			TOF	18 - 7%
Definitely	23 - 9%			Ebstein's	2 - 1%
10. Most Common complication?		11. Repaired CHD = normal?		12. Adequate resources?	
Thromboembolism	77 - 29%				
Pulmonary Stenosis	7 - 3%	True	84 - 31%	Yes	58 - 22%
Hypoxia	25 - 9%	False	185 - 69%	No	111 - 41%
Heart Failure	111 - 41%			Not Sure	100 - 37%
Aortic dissection	5 - 2%				
CAD	14 - 5%				
Hypertension	30 - 11%				

13. Most frequently used resource?		14. Education about ACHDs helpful?		15. Preferred learning method?	
UP To Date	11 - 4%	No	1 - 0%	Online	61 - 23%
Epocrates	4 - 1%	Probably not	11 - 4%	Online & classroom	120 - 45%
Data base search	15 - 6%	Don't know	22 - 8%	Traditional class	41 - 15%
Care Notes	9 - 3%	Most likely	129 - 48%	Self study	47 - 17%
Krames Guides	5 - 2%	Yes	106 - 39%		
Textbooks	14 - 5%				
Google/Scholar	59 - 22%				
Co-workers	144 - 54%				
Other	6 - 2%				
Not Applicable	2 - 1%				

(IP – inpatient, OP –outpatient, I/O – inpatient/outpatient, PACU-postanesthesia care unit, OR-operating room, ICU-intensive care unit, Cath-cardiac cath lab, occ-occasionally, freq-frequently, NICU- neonatal intensive care unit, ED-emergency department, CAD – coronary artery disease, CHD –congenital heart defect, ASD-atrial septal defect, VSD-ventricular septal defect, BAV- bicuspid aortic valve, TOF – tetralogy of fallot)

APPENDIX

Anatomical Findings	Vital structure in fetal life, normally closes after birth. When remains patent, leads to left to right shunting with increased pulmonary flow and left heart volume overload
Clinical Presentation	<p>Symptoms (depends on the size of PDA):</p> <ul style="list-style-type: none"> • Small: Asymptomatic, often detected incidentally (murmur echocardiogram) • Moderate-large <ul style="list-style-type: none"> ○ Exercise intolerance ○ CHF ○ Atrial fibrillation ○ Eisenmenger (large) <p>Examination (if significant shunt):</p> <ul style="list-style-type: none"> • Bouncy pulses, wide pulse pressure low diastolic pressure • Prominent ventricular impulse • Continuous murmur in the left infraclavicular area, radiates to the back • Eisenmenger: Differential cyanosis (cyanosis + clubbing of toes more than fingers), usually no murmurs
Management	<p>PDA closure recommended:</p> <ol style="list-style-type: none"> 1. Significant left-to-right shunt + LV dilatation 2. To eliminate the risk of endocarditis 3. Not if silent tiny duct or irreversible PAH <p>Device closure:</p> <ul style="list-style-type: none"> • Is the preferred method, and should be considered even in presence of severe pulmonary hypertension, if reversible <p>Surgical closure:</p> <ul style="list-style-type: none"> • Reserved for: PDA too large, too distorted
Outcome Complications	<p>Complications:</p> <ul style="list-style-type: none"> • Congestive heart failure • Pulmonary vascular disease • Endarteritis • Aneurysm of the ductus arteriosus

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