

Children's Mercy Kansas City

## SHARE @ Children's Mercy

---

Manuscripts, Articles, Book Chapters and Other Papers

---

12-5-2018

### Innocent Heart Murmur.

Arpan R. Doshi

*Children's Mercy Hospital*

Follow this and additional works at: <https://scholarlyexchange.childrensmercy.org/papers>



Part of the [Cardiology Commons](#), [Cardiovascular System Commons](#), [Diagnosis Commons](#), and the [Pediatrics Commons](#)

---

#### Recommended Citation

Doshi, A. R. Innocent Heart Murmur. *Cureus* 10, 3689-3689 (2018).

This Article is brought to you for free and open access by SHARE @ Children's Mercy. It has been accepted for inclusion in Manuscripts, Articles, Book Chapters and Other Papers by an authorized administrator of SHARE @ Children's Mercy. For more information, please contact [library@cmh.edu](mailto:library@cmh.edu).

# Innocent Heart Murmur

Arpan R. Doshi<sup>1</sup>

1. Pediatric Cardiology, Children's Mercy Hospitals and Clinics, Wichita, USA

✉ **Corresponding author:** Arpan R. Doshi, ardoshi@cmh.edu

Disclosures can be found in Additional Information at the end of the article

---

## Abstract

Heart murmur is the most common reason for a referral to a pediatric cardiologist. Virtually all children have a heart murmur during their childhood. Less than 1% of murmurs are pathological in children. Innocent/functional heart murmur is the most common type of heart murmur. There are multiple theories proposed to identify etiology of innocent heart murmur with varying consensus, but everybody agrees that innocent heart murmur does not carry any morbidity or mortality risk. Even today, heart murmur is associated with high physician uncertainty and parental anxiety. Extensive cardiac evaluation for such a benign finding is also associated with high health care utilization and cost. This article attempts to review this long-known finding which continues to remain a diagnostic challenge.

---

**Categories:** Cardiology, Family/General Practice, Pediatrics

**Keywords:** murmur, innocent heart murmur, functional heart murmur, pediatric murmur, flow murmur, heart murmur

## Introduction And Background

Cardiac murmurs have remained a “hot topic” in cardiac evaluation since the invention of the stethoscope by Rene Laennec in the early 17th century [1]. Heart murmur continues to remain the most common reason for referral to pediatric cardiologist [2]. Less than 1% of pediatric heart murmurs are associated with congenital heart disease, and most of the heart murmurs are innocent in nature [3]. Terminologies like “innocent”, “physiologic”, “benign”, “normal” or “functional” are frequently used but calling it “innocent” clearly conveys the non-pathological nature of this finding to the parents and patients.

Murmur is a sound produced by vibrations caused by the flow of blood through the heart [4]. Several different mechanisms are proposed regarding the development of any murmur such as turbulence from the blood flow, cardiac vibrations, Bernoulli effect, eddy current, etc. Dr. George Frederic Still, in the year 1909, first described “musical murmur” in pediatric patients and deemed it as innocent [5].

## Review

### Types of innocent heart murmurs

Innocent heart murmurs in children can be categorized under four distinct groups: Still’s vibratory murmur, pulmonary flow murmur, supraclavicular systemic flow murmur, and venous hums. Many high output states like anemia, fever, arteriovenous malformation, etc. can also result in heart murmur [5].

Still’s murmur: McKusick et al. very appropriately suggested the musical instrument, Aeolian

Received 11/26/2018

Review began 11/29/2018

Review ended 11/29/2018

Published 12/05/2018

© Copyright 2018

Doshi. This is an open access article distributed under the terms of the Creative Commons Attribution License CC-BY 3.0., which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

### How to cite this article

Doshi A R (December 05, 2018) Innocent Heart Murmur. Cureus 10(12): e3689. DOI 10.7759/cureus.3689

Island harp, as an analogue for Still's murmur [6]. Still's murmur is a brief, vibratory quality, grade 1-3, midsystolic, and low-pitched murmur. This is best heard with the bell of a stethoscope. This murmur is heard at the left lower sternal border and occasionally radiates to the cardiac apex. Typical age group for this murmur is three years to early adolescence, but it can be present at any age. Because the innocent murmurs are produced by normal flow dynamics, any alteration in the flow with a change in patient position will change the murmur characteristics. This murmur is the loudest in the supine position and it diminishes in intensity when a child is made to sit or stand up, as these positions diminish the venous return to the heart. This could be a valuable tool while examining Still's murmur in the clinic.

Some of the proposed mechanisms for the development of Still's murmur are the presence of "fibrous bands" or "false tendon" in the left ventricle [7-8], smaller aortic size causing increase in the flow velocity [9], insertion of tricuspid valve chordae into the right ventricular outflow tract [5], increased left ventricular output with relative bradycardia [10], vibrations from cardiac structures [10], and lower aortic arterial elastance with a higher left ventricular contractility [11]. There is no clear consensus on the mechanism of its origin at this time.

**Pulmonary flow murmur:** This is a harsh quality, grade 2-3, medium-high pitched, ejection systolic murmur. This murmur is best heard with the diaphragm of a stethoscope. It is thought to originate from the right ventricular outflow. It is best heard at the left upper sternal border over the "pulmonary area" and it often radiates to the back and/or axillae. This murmur can be very prominent in high output states and in patients with pectus excavatum deformity of the chest. Pulmonary flow murmur can be differentiated from pulmonary valve stenosis murmur by its quality and absence of pulmonary valve click. Pulmonary flow murmur is also very responsive to change in flow dynamics. The intensity increases with inspiration and lying down due to an increase in venous return, and decreases with standing up and Valsalva maneuver.

**Supraclavicular systemic flow murmur:** This is a harsh quality, crescendo-decrescendo, medium-high pitched, grade 2-3 murmur heard over the supraclavicular region with radiation to the carotids. This murmur is best heard with the diaphragm of a stethoscope and can be present in any pediatric age group as well as young adults. In contrast to aortic valve stenosis murmur, this is not accompanied by the systolic click of the aortic valve. This murmur is thought to arise from the normal flow of blood from the aorta into head-and-neck vessels [12]. This murmur is loudest in a supine position and it diminishes in intensity with hyperextension of the neck.

**Venous hum:** This is a continuous low-pitched murmur best heard over the lower neck, just lateral to the sternocleidomastoid muscles. This originates from the systemic venous return of the superior vena cava. Due to its low-pitch, it is best heard with the bell of a stethoscope. This murmur is very sensitive to position and disappears with making the child look down or to the side. It is most prominent in the sitting position and diminishes or disappears on lying down. This can be easily differentiated by patent ductus arteriosus murmur which is harsh machinery in character and does not change or disappear with changing neck position.

## **Assess beyond the murmur**

A pediatric cardiovascular examination should not primarily focus and end with listening for the presence or absence of heart murmur. A detailed birth history, past medical history, growth chart assessment, detailed family history, and head-to-toe assessment are essential components that help with making a competent clinical diagnosis [3]. Many of the complex and serious cardiovascular abnormalities may not present with a heart murmur. A cardiovascular exam should include inspection and palpitation of precordium, assessment of peripheral pulses, assessment of perfusion, abdominal organomegaly, etc. in addition to auditory assessment. Lastly, auscultation should include assessment of heart sounds (S1 and S2) first

before focusing on the heart murmur. In the pediatric population, the sequence of assessment may need to be modified based on the patient's age and level of cooperativeness.

## **Impact beyond the patient**

Referral of a child to a cardiologist for evaluation of innocent heart murmur has a significant impact that extends beyond the patient. Diagnosis of heart murmur, even if innocent, is associated with significant healthcare resource utilization and parental/caregiver anxiety [13-17]. Appropriate use criteria for initial transthoracic echocardiography were released by the American Academy of Pediatrics, American Heart Association, American Society of Echocardiography, Heart Rhythm Society, etc. in the year 2014 which clearly notes transthoracic echocardiogram for presumed innocent heart murmur as “rarely appropriate” indication [18]. Despite published guidelines, there is a significant utilization of transthoracic echocardiography as well as recurrent cardiology visits for innocent heart murmur [13-14]. Giuffre et al. and Bardsen et al. looked at parental anxiety after a diagnosis of childhood heart murmur [15,17]. Both studies reported significantly higher anxiety level in parents after the initial diagnosis. Even when the parents were given a handout regarding innocent heart murmur prior to the evaluation by a cardiologist, it did not decrease the anxiety significantly. Parental anxiety was significantly relieved after evaluation and counselling by a pediatric cardiologist. It should be further explained to parents that child may never “outgrow” the murmur and murmur may only be intermittently audible.

## **Role of auditory training and computer-aided auscultation devices**

Auscultation skill is the cornerstone of competent cardiovascular examination. Evaluation of heart sounds and heart murmur plays an important role in making an accurate cardiac diagnosis and dictate the management plan. But with modernization and availability of various “gadgets” in medicine, unfortunately, this is becoming a neglected skill [19]. Suboptimal performance by practicing physicians and medical trainees has been well documented in various studies [20-21]. Finley et al. showed in their study that well planned auditory training program rapidly teaches students to distinguish between innocent and pathological murmur with at least 90% accuracy [22]. They also further show that the skill level does decline over time but can be remastered with repeat training. Repetition and practice are the key factors to master auscultation skills [23].

There are a few commercially available softwares in the market designed to aid with determining pathological nature of a heart murmur [24]. These softwares have improved significantly over time but they still lag high specificity and sensitivity for making an accurate diagnosis consistently. Additionally, the patient's age and heart rate significantly affect its sensitivity and specificity. These softwares put forward a very promising premise for use by frontline providers to differentiate innocent vs pathological murmur with high certainty. But for the time being they are not ready for routine use in author's opinion.

## **Conclusions**

In conclusion, innocent heart murmur is a benign/functional sound produced by a flow of blood through the heart. It remains a significant source of diagnostic uncertainty among primary care physicians and it is still the most common reason for a referral to a pediatric cardiologist. Despite being an “innocent finding”, it still remains a significant source of health care resource utilization and parental anxiety.

## **Additional Information**

## Disclosures

**Conflicts of interest:** In compliance with the ICMJE uniform disclosure form, all authors declare the following: **Payment/services info:** All authors have declared that no financial support was received from any organization for the submitted work. **Financial relationships:** All authors have declared that they have no financial relationships at present or within the previous three years with any organizations that might have an interest in the submitted work. **Other relationships:** All authors have declared that there are no other relationships or activities that could appear to have influenced the submitted work.

## References

1. Permin H, Norn S: The stethoscope - A 200th anniversary . *Dan Medicinhist Arbog*. 2016, 44:85-100.
2. McCrindle BW, Shaffer KM, Kan JS, Zahka KG, Rowe SA, Kidd L: Factors prompting referral for cardiology evaluation of heart murmurs in children. *Arch Pediatr Adolesc Med*. 1995, 149:1277-1279. [10.1001/archpedi.1995.02170240095018](https://doi.org/10.1001/archpedi.1995.02170240095018)
3. Biancaniello T: Innocent murmurs. *Circulation*. 2005, 111:20-22. [10.1161/01.CIR.0000153388.41229.CB](https://doi.org/10.1161/01.CIR.0000153388.41229.CB)
4. Naik RJ, Shah NC: Teenage heart murmurs. *Pediatr Clin North Am*. 2014, 61:1-16. [10.1016/j.pcl.2013.09.014](https://doi.org/10.1016/j.pcl.2013.09.014)
5. Guntheroth WG: Innocent murmurs: a suspect diagnosis in non-pregnant adults . *Am J Cardiol*. 2009, 104:735-737. [10.1016/j.amjcard.2009.04.031](https://doi.org/10.1016/j.amjcard.2009.04.031)
6. McKusick VA, Murray GE, Peeler RG, Webb GN: Musical murmurs. *Bull Johns Hopkins Hosp*. 1955, 97:136-176.
7. Perry LW, Ruckman RN, Shapiro SR, Kuehl KS, Galioto FM Jr, Scott LP III: Left ventricular false tendons in children: prevalence as detected by 2-dimensional echocardiography and clinical significance. *Am J Cardiol*. 1983, 52:1264-1266. [10.1016/0002-9149\(83\)90584-2](https://doi.org/10.1016/0002-9149(83)90584-2)
8. Darazs B, Hesdorffer CS, Butterworth AM, Ziady F: The possible etiology of the vibratory systolic murmur. *Clin Cardiol*. 1987, 10:341-346. [10.1002/clc.4960100509](https://doi.org/10.1002/clc.4960100509)
9. Klewer SE, Donnerstein RL, Goldberg SJ: Still's-like innocent murmur can be produced by increasing aortic velocity to a threshold value. *Am J Cardiol*. 1991, 68:810-812. [10.1016/0002-9149\(91\)90664-7](https://doi.org/10.1016/0002-9149(91)90664-7)
10. Gardiner HM, Joffe HS: Genesis of Still's murmurs: a controlled Doppler echocardiographic study. *Br Heart J*. 1991, 66:217-220. [10.1136/hrt.66.3.217](https://doi.org/10.1136/hrt.66.3.217)
11. Engel J, Baumgartner S, Novak S, Male C, Salzer-Muhar U: Ventriculo-arterial coupling in children with Still's murmur. *Physiol Rep*. 2014, 2:2-10. [10.14814/phy2.12041](https://doi.org/10.14814/phy2.12041)
12. Leatham A, Segal B, Shafter H: Auscultatory and phonocardiographic findings in healthy children with systolic murmurs. *Br Heart J*. 1963, 25:451-459. [10.1136/hrt.25.4.451](https://doi.org/10.1136/hrt.25.4.451)
13. Loisel KA, Lee JL, Gilleland J, et al.: Factors associated with healthcare utilization among children with noncardiac chest pain and innocent heart murmurs. *J Pediatr Psychol*. 2012, 37:817-825. [10.1093/jpepsy/jss055](https://doi.org/10.1093/jpepsy/jss055)
14. Dalal NN, Dzelebdzic S, Frank LH, et al.: Recurrent cardiology evaluation for innocent heart murmur: echocardiogram utilization. *Clin Pediatr*. 2018, 57:1436-1441. [10.1177/0009922818787280](https://doi.org/10.1177/0009922818787280)
15. Bardsen T, Sorbye MH, Tronnes H, Greve G, Berg A: Parental anxiety related to referral of childhood heart murmur; an observational/interventional study. *BMC Pediatr*. 2015, 15:193. [10.1186/s12887-015-0507-4](https://doi.org/10.1186/s12887-015-0507-4)
16. Geggel RL, Horowitz LM, Brown EA, Parsons M, Wang PS, Fulton DR: Parental anxiety associated with referral of a child to a pediatric cardiologist for evaluation of a Still's murmur. *J Pediatr*. 2002, 140:747-752. [10.1067/mpd.2002.124379](https://doi.org/10.1067/mpd.2002.124379)
17. Giuffre RM, Walker I, Vaillancourt S, Gupta S: Opening Pandora's box: parental anxiety and the assessment of childhood murmurs. *Can J Cardiol*. 2002, 18:406-414.
18. Campbell RM, Douglas PS, Eidem BW, Lai WW, Lopez L, Sachdeva R: ACC/AAP/AHA/ASE/HRS/SCAI/SCCT/SCMR/SOPE 2014 appropriate use criteria for initial transthoracic echocardiography in outpatient pediatric cardiology: a report of the American College of Cardiology Appropriate Use Criteria Task Force, American Academy of Pediatrics,

- American Heart Association, American Society of Echocardiography, Heart Rhythm Society, Society for Cardiovascular Angiography and Interventions, Society of Cardiovascular Computed Tomography, Society for Cardiovascular Magnetic Resonance, and Society of Pediatric Echocardiography. *J Am Coll Cardiol*. 2014, 64:2039-2060. [10.1016/j.jacc.2014.08.003](https://doi.org/10.1016/j.jacc.2014.08.003)
19. Conn RD, O'Keefe JH: Cardiac physical diagnosis in the digital age: an important but increasingly neglected skill (from stethoscopes to microchips). *Am J Cardiol*. 2009, 104:590-595. [10.1016/j.amjcard.2009.04.030](https://doi.org/10.1016/j.amjcard.2009.04.030)
  20. Mangione S, Nieman LZ: Cardiac auscultatory skills of internal medicine and family practice trainees. A comparison of diagnostic proficiency. *JAMA*. 1997, 278:717-722.
  21. Gaskin PR, Owens SE, Talner NS, Sanders SP, Li JS: Clinical auscultation skills in pediatric residents. *Pediatrics*. 2000, 105:1184-1187. [10.1542/peds.105.6.1184](https://doi.org/10.1542/peds.105.6.1184)
  22. Finley JP, Caissie R, Nicol P, Hoyt B: International trial of online auditory training programme for distinguishing innocent and pathological murmurs. *J Paediatr Child Health*. 2015, 51:815-819. [10.1111/jpc.12839](https://doi.org/10.1111/jpc.12839)
  23. Barrett MJ, Lacey CS, Sekara AE, Linden EA, Gracely EJ: Mastering cardiac murmurs: the power of repetition. *Chest*. 2004, 126:470-475. [10.1378/chest.126.2.470](https://doi.org/10.1378/chest.126.2.470)
  24. Lee C, Rankin KN, Zuo KJ, Mackie AS: Computer-aided auscultation of murmurs in children: evaluation of commercially available software. *Cardiol Young*. 2016, 26:1359-1364. [10.1017/S1047951115002656](https://doi.org/10.1017/S1047951115002656)