Current Issue

ORIGINAL ARTICLE

Correlation between grading of fat infiltration in multifidus muscle and degree of facet joint arthropathy in degenerative spondylolisthesis patients based on lumbosacral MRI: a cross-sectional study

Chin Edward Chandra, Dario Agustino Nelwan, Muhammad Ilyas, Andriany Qanitha, Karya Triko Biakto, Sri Asriyani

ORIGINAL ARTICLE

Improvement in body composition after 12-week basic combat training: a longitudinal study among Republic of Indonesia Defense University cadets

Dwi Monik Purnamasari, Ahmad Syafiq, Ratu Ayu Dewi Sartika, Leonardo Lubis, Asih Setiarini, Fathimah Sulistyowati Sigit , Trini Sudiarti , Zaini Saragih , Endang Laksminingsih Achadi , Besral

Vol. 9 No. 2 (2020): (Available online: 1 August 2020)

ORIGINAL ARTICLE

Impaired cognitive function and its relationship with menopausal onset and exercise intensity of elderly women

Ni Luh Kadek Alit Arsani, Ni Nyoman Mestri Agustini, Ni Putu Dewi Sri Wahyuni

Online First: Jun 12, 2020 |

Abstract | PDF

ORIGINAL ARTICLE

Comparison of direct medical cost between ramipril and candesartan in hospitalized acute decompensated heart failure at West Nusa Tenggara Regional Hospital

Nurul Qiyaam, Baiq Leny Nopitasari, Baiq Leny Nopitasari, Cyntiya Rahmawati, Baiq Nurbaety, Emasiska Ajeng Pratiwi

Online First: Aug 11, 2020 |

Abstract | PDF

ORIGINAL ARTICLE

Characteristic gynaecology-oncology patients from Obstetrics and Gynaecology Outpatient Clinic Mangusada Regional Hospital Badung reffered to Sanglah Hospital from 1st January 2016 - 31st December 2018

Bagus Ngurah Brahmantara, Ida Bagus Made Kartha, I Nyoman Gede Budiana

Online First: Aug 1, 2020 |

Abstract | PDF

ORIGINAL ARTICLE

Prevalence of ABO, RhD and other clinically significant Blood Group Antigens among blood donors at tertiary care center, Gwalior

Shelendra Sharma, dharmesh chandra sharma, Sunita Rai, Anita Arya, Reena Jain, Dilpreet Kaur, Bharat Jain

Online First: Aug 1, 2020 |

Abstract | PDF

ORIGINAL ARTICLE

The effects of meldonium on microrheological abnormalities of erythrocytes in rats with obesity : An experimental study

Evgeny Vladimirovich Kulikov, Svetlana Yuryevna Zavalishina, Yury Anatolyevich Vatnikov, Sergey Borisovich Seleznev, Valentina Ivanovna Parshina, Yuliya Yurevna Voronina, Irina Anatolyevna Popova, Irina Viktorovna Bondareva, Olesia Anatolyevna Petrukhina, Natalya Igorevna Troshina, Tatyana Ivanovna Glagoleva

Online First: Aug 1, 2020 |

Abstract | PDF

ORIGINAL ARTICLE

The correlations of knowledge, attitude, and smoking behaviour with smoking cessation effort at coffee shops in Banda Aceh, Indonesia

Muhammad Faris Alfianto, Yopie Afriandi Habibie, Muhammad Ridwan, Teuku Zulfikar, Liza Salawati

Online First: Aug 1, 2020 |

Abstract | PDF

ORIGINAL ARTICLE

Psychological comfort in patients with lumbar spine osteochondrosis treated with daily therapeutic-prophylactic clothes over 6 months

Albina Ahatovna Bikbulatova, Elena Georgievna Andreeva

Online First: Aug 1, 2020 |

Abstract | PDF

ORIGINAL ARTICLE

Relationship between Interleukin-18 (IL-18) level and Mean Platelet Volume (MPV) with ischemic stroke event in Sanglah General Hospital, Bali, Indonesia

Anak Agung Ngurah Subawa, Dewa Putu Gde Purwa Samatra, Desak Gde Diah Dharma Santhi

Online First: Jul 11, 2020 |

Abstract | PDF

REVIEW

Spine injury: how to recognize and stabilize patient in golden hours periods

Azharuddin Azharuddin

Online First: Aug 1, 2020 |

Abstract | PDF

REVIEW

Brain alteration in chronic pain and the relationship with pain score

Endang Mutiawati, Syahrul Syahrul, Nasrul Musadir

Online First: Aug 1, 2020 |

Abstract | PDF

REVIEW

Position paper from the Indonesian Society of Thrombosis and Hemostasis (InaSTH), Semarang chapter: Management of coagulopathy in COVID-19

Eko Adhi Pangarsa, Budi Setiawan, Damai Santosa, Ridho M. Naibaho, Daniel Rizky, Suyono -, Mika L. Tobing, Catharina Suharti

Online First: Jul 14, 2020 |

Abstract | PDF

REVIEW

The molecular mechanisms of secondary osteoporosis: a literature review

Akif Hajiyev, Gulnara Azizova, Arif Efendiyev

Online First: Aug 1, 2020 |

Abstract | PDF

REVIEW

Hemodynamic changes in patients undergoing cemented total hip replacement surgery: a literature review

Putu Astawa

Online First: Aug 1, 2020 |

Abstract | PDF

CASE REPORT

Osseous choristoma of the tongue: A rare disease

Boon Chin Te, Mohd Ayzam Ahmad, Mohd Razif Mohamad Yunus, Noorasmaliza Md Paiman

Online First: Jun 12, 2020 |

Abstract | PDF

CASE REPORT

Aortic enlargement: a case report of cadaveric heart and great vessels dimensions

Mauritius Lambertus Edy Parwanto, Dian Mediana, Diana Samara, Magdalena Wartono, Alfred Pakpahan, Haryo Ganeca Widyatama

Online First: Jun 12, 2020 |

Abstract | PDF

CASE REPORT

Multifaceted rehabilitation strategies for ramsay hunt syndrome: a case report and a review of literature

Ni Made Ratih Purnama Dewi, Bagus Diva Indra Dharma, I G N M Dedi Silakarma, Gede Wara Samsarga

Online First: Aug 1, 2020 |

Abstract | PDF

CASE REPORT

Collaborative management of pediatric duplex collecting system with upper pole hydronephrosis, vesicoureteral reflux, and ureterocele: A case report

Kirana Dyah Larasati Budhiarta, Ketut Suarta, Gede Wirya Kusuma Duarsa, Pande Putu Yuli Anandasari

Online First: Aug 1, 2020 |

Abstract | PDF

CASE REPORT

A rare case report of extensive abdominopelvic endometriosis mimicking peritoneal malignancy: an imaging investigation

Warissara Jutidamrongphan, Thorsang Chayovan, Teeravut Tubtawee, Keerati Hongsakul

Online First: Aug 1, 2020 |

Abstract | PDF

Editor-in-Chief

Prof. Dr. Sri Maliawan, SpBS
(Scopus ID), (Google scholar)
srimaliawan@unud.ac.id / maliawans@yahoo.com
Department of Neuro Surgery, Udayana University
Sanglah General Hospital
Bali - Indonesia

Associate Editor

Prof. Putra Manuaba, M.Phil
(Scopus ID), (Google Scholar)
putramanuaba@unud.ac.id / putramanuaba28@yahoo.com
Biomedicine Postgraduate Program, Udayana University
Bali - Indonesia

Prof. Ketut Suwiyoga, SpOG
(Scopus ID)
suwiyoga@unud.ac.id
Faculty of Medicine, Udayana University, Sanglah Hospital Denpasar, Bali-Indonesia

Editorial Board for Regional America

Ankit Sakhuja, M.B.B.S., F.A.C.P., F.A.S.N.
(Scopus ID)
asakhuja@med.umich.edu
Nephrology and Hypertension Cleveland Clinic (United States)

Editorial Board for Regional Australia

Professor John Svigos, AM
MBBS; DRCOG; CBioEth; FRCOG; FRANZCOG
(Scopus ID)
john@svigos.com.au
Discipline of Obstetrics & Gynaecology
Faculty of Health & Medical Sciences
University of Adelaide, South Australia

dr Deasy Ayuningtyas Tandio MPH-MBA.
(OrcidID)
deasytandio@yahoo.com
James Cook University Australia Master of Public Health Master Of Business Administration, Indonesia

---

CASE REPORT

Bali Medical Journal (*Bali Med J*) 2020, Volume 9, Number 2: 416-418
P-ISSN.2089-1180, E-ISSN.2302-2914

Published by DiscoverSys

Aortic Enlargement: A Case Report of Cadaveric Heart and Great Vessels Dimensions

Mauritius Lambertus Edy Parwanto,[1*] Dian Mediana,[2] Diana Samara,[2] Magdalena Wartono,[2] Alfred Pakpahan,[3] Haryo Ganeca Widyatama[4]

ABSTRACT

Aortic enlargement is not an uncommon incidental finding with potential omission of clinical implications. During routine dissection in the middle of the thorax, there was an incidental finding of a disproportionately enlarged aorta in comparison to normal-sized heart at gross observation despite normal anatomy in local and adjacent structures. Incidental finding of aortic enlargement should not be disregarded as it might contribute to pathological processes. The use of indices could give a more comprehensive appraisal of cardiovascular system dimensions.

Keywords: aortic enlargement, heart, great vessels, dimension, cadaver.
Cite This Article: Parwanto, M.L.E., Mediana, D., Samara, D., Wartono, M., Pakpahan, A., Widyatama, H.G. 2020. Aortic Enlargement: A Case Report of Cadaveric Heart and Great Vessels Dimensions. *Bali Medical Journal* 9(2): 416-418. DOI:10.15562/bmj.v9i2.1817

[1]Department of Biology, Faculty of Medicine, Universitas Trisakti, Indonesia
[2]Department of Anatomy, Faculty of Medicine, Universitas Trisakti, Indonesia
[3]Department of Biology, Faculty of Dentistry, Universitas Trisakti, Indonesia
[4]Department of Histology, Faculty of Medicine, Universitas Trisakti, Indonesia.

*Correspondence to:
Mauritius Lambertus Edy Parwanto, Department of Biology, Faculty of Medicine, Universitas Trisakti, Jl. Kyai Tapa, Kampus B, No.260 Grogol 11440, Jakarta-Indonesia.
edyparwanto@trisakti.ac.id

Received: 2020-05-10
Accepted: 2020-06-08
Published: 2020-08-01

INTRODUCTION

The aorta serves as a main artery in the body owing to its large size and direct extension from the heart. Along its course through the thorax down to the abdomen it changes in three different orientations and is subdivided into three sections thereof, namely ascending aorta, aortic arch (AA), and descending aorta. Three vessels originating from superior convex part of the arch are brachiocephalic artery (BCA), left common carotid artery (LCCA), and left subclavian artery (LSCA) – which are collectively referred to as the great vessels. Towards the left and posterior of aorta lies another cardiac outflow tract named pulmonary artery, which bifurcates below the AA and enter each side of the lungs.[1-3]

Apart from normal anatomical variants, pathological processes resulting from early developmental errors or acquired changes later in life could lead to anomalous morphology of these vessels. Aortic enlargement is not an uncommon incidental finding with potential omission of clinical implications. Although the risk of aortic dilatation per se remains an enigma, once progression to aneurysm occurs, it could lead to acute fatal consequences.[4-6] This present study describes a rare cadaveric finding of aortic enlargement along with heart and great vessels dimensions.

CASE REPORT

During routine dissection in the middle of the thorax, there was an incidental finding of a disproportionately enlarged aorta in comparison to normal-sized heart at gross observation. The heart along with its great vessels were fixed using 10% formalin. This specimen was obtained from a fresh-frozen male Indonesian cadaver whose age at death was 36 years old.

External cardiac dimensions were presented in Figure 1. Heart length and width were 91.8 mm and 85.4 mm, respectively. Heart length index of 93.03 was calculated as the percentage of heart width/heart length.

Aortic size seemed to exceed the normal proportion compared with the heart as shown in the frontal and antero-frontal view. The whole structures of aorta including aortic root, ascending aorta, aortic arch, and descending aorta were expanded thoroughly (Figure 2).

Dimensions of the great vessels were provided in Table 1. Overall (96.95) and middle (27.08) aortic arch indices were calculated by these following two formulas, respectively: (aortic arch length/heart length*100) and (diameter of middle part of the aortic arch/length of the aortic arch*100).

DISCUSSION

Existing works of literature attempting to establish normal reference of heart and great vessels dimensions in postmortem setting were relatively scant. In the recent *Gray's anatomy* textbook it was cited that the average adult heart length and transverse diameter were 12 cm and 8-9 cm, respectively.[7] A large scale cadaveric study on normal heart size involving 550 cadavers of Iranian population revealed a wider reference range of heart length (11.41±2.15 cm) and width (8.21±4.38 cm). Specific mean heart length (11.89±1.60 cm) and width (8.98±7.17 cm) for matching age group (30-39 years) were provided

Table 1 Dimensions of the great arteries

Parameters	Measurement results (mm)
Length of AA	89.0
External diameter of proximal BCA	15.2
External diameter of proximal PA	28.0
Diameter of middle AA	24.1
Diameter of distal AA	17.5
External diameter of proximal LCCA	7.9
Internal diameter of proximal LCCA	6.0
External diameter of proximal LSCA	11.7
Internal diameter of proximal LSCA	9.5

AA: aortic arch; BCA: brachiocephalic artery; LCCA: left common carotid artery; LSCA: left subclavian artery; PA: pulmonary artery.

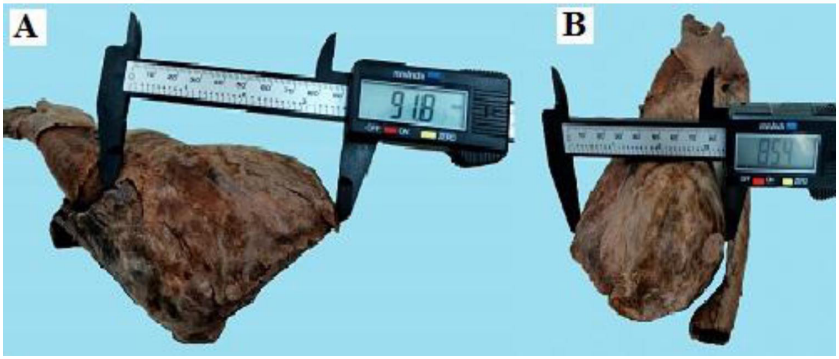

Figure 1 External cardiac dimensions. (A) Heart length measured 91.8 mm. (B) Heart width measured 85.4 mm

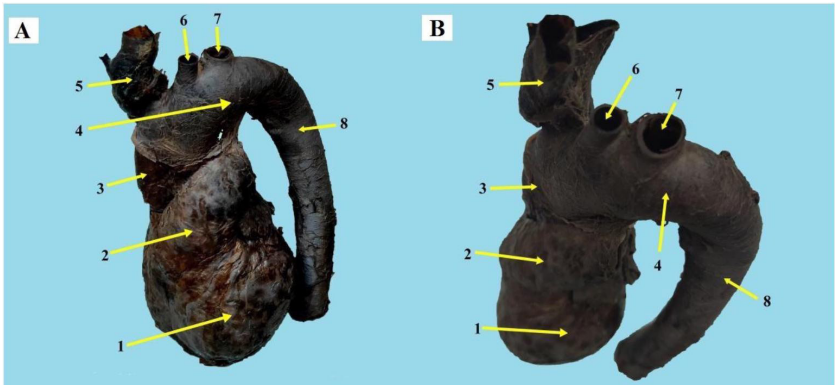

Figure 2 Photograph of the heart with surrounding great vessels. (A) Frontal view. (B) Antero-frontal view. 1, ventricle; 2, atrium; 3, ascending aorta; 4, aortic arch; 5, ascending aorta; 6, left common carotid artery; 7, left subclavian artery; 8, descending thoracic aorta

for more accurate comparison with the current study.[8] Former similar study in adult Bangladeshi decedents further specified the mean length and width for each gender. Male mean heart length (10.5±0.62 cm) and width (8.51±0.61) were more prominent than the female counterpart.[9] Heart width in current study was well within aforementioned reference ranges, while the length was below all the references.

The previous study by Redheuil et al. involving aortic arch length measurement was done using magnetic resonance imaging on a general population study sample who were free of overt cardiovascular disease. Reported mean aortic arch length for male was 122±21 mm. Despite its original aim in studying age-related changes in aortic arch geometry, the result was deemed comparable as the male patients had a mean age of 45±15 years.[10] Two other studies assessed aortic arch diameter similarly using computed tomography (CT) in both living cohort and cadavers. American College of Radiology aimed to establish normative reference values for aortic diameter as a part of a trial (National Lung Screening Trial) which include lung cancer patients. The mean diameter in axial (2.78±0.29 cm) and sagittal oblique (2.73±0.28 cm) CT was obtained.[11] An anatomical study by Aboulhoda et al. in ten adult Egyptian cadavers found mean outer aortic arch diameter of 33.83±4.03 mm proximally and 22.06±2.77 mm distally.[12] Preceding absolute measurement parameters of aortic arch were proven to be larger than that of this decedent, however we highlight the importance to take relative measurement as indices into account.

In an attempt to construct a comprehensive comparison of heart and great vessels dimensions, indices value intervals were generated from the combination of available age and gender specified normal reference ranges. Based on similar studies[8,9] the range of heart length (9.88-13.49 cm) and width (7.9-9.12 cm) were obtained, yielding heart length index value of 58.56-92.31. Additional precaution by truncating standard deviation value was taken when interpreting age-specific heart width from previous study as the range was considerably wide. Similarly, aortic arc length range (10.1-14.3 cm) extracted from the study by Redheuil et al.[10] resulted in overall aortic arch index value of 74.87-144.74. Interval range for the middle aortic arch index of 17.13-31.09 was derived from two prior studies.[11-12] Indices from this study were greater than secondarily derived reference values of past studies.

A cadaveric investigation of great vessels morphology in Korean adults investigated mean internal diameters of BCA (18.3 ± 7.0 mm), LCCA (9.8 ± 1.9), and LSCA (10.6 ± 2.4).[13] Measurements of the outer diameter of BCA (15.7±7.42 mm), LCCA (11.42±4.72 mm), and LSCA (14.02±6.8 mm) were also found by Aboulhoda et al.[12] Mean external diameters of BCA (18.0±3.8 mm), LCCA (12.6±2.7 mm), and LSCA (14.1±2.5 mm) were measured by CT aortograms in over a hundred of Asian patients without previous open surgery or endovascular treatment of the thoracic aorta.[14] Comparable internal dan external diameters were found in this report except for smaller internal LCCA diameter.

In contrast to other dimensions of interest, pulmonary artery diameter was more rigorously researched and therefore had fixed normative value established. Both studies covered in this topic used CT as their imaging modality, but the main difference lies in the study population recruited. An earlier study in healthy adults showed mean PA diameter of 24.0±2.8 mm without significant gender difference.[15] While later study as a part of community-based Framingham Heart Study revealed comparable diameter (25.1±2.8 mm), more straightforward gender-specific normative reference was determined for men (29 mm) and women (27 mm).[16] These results confirmed a normal PA size in this case.

Cardiovascular system function on hemodynamic maintenance is a resultant of both cardiac and vessels integration.[17] Great deal of effort was put on working towards determining certain predictive vessel diameter cut-off value in relation to risk prognostication and optimal management of relevant diseases.[18-20] We propose the application of indices that would better reflect cardiovascular system dimensions as a whole rather than separately.

CONCLUSION

Incidental finding of aortic enlargement should not be disregarded as it might contribute to pathological processes. The use of indices could give a more comprehensive appraisal of cardiovascular system dimensions.

ACKNOWLEDGEMENTS

We would like to thank Mr Dian and Heru for their support in the cadaver photoshoot.

CONFLICTS OF INTEREST

The authors declare that they have no competing interests.

FUNDING

All authors have no support or funding to report.

AUTHORS CONTRIBUTIONS

Conceptualization: MLEP. Data acquisition: MLEP, DM, DS and MW. Data analysis or interpretation: all authors. Drafting of the manuscript: MLEP, DM, HGW. Critical revision of the manuscript: DM, DS, MW, AP, HGW. Approval of the final version of the manuscript: all authors.

REFERENCES

1. Komutrattananont P, Mahakkanukrauh P, Das S. Morphology of the human aorta and age-related changes: anatomical facts. Anat Cell Biol. 2019;52(2):109-114.
2. Dagenais F. Anatomy of the thoracic aorta and of its branches. Thorac Surg Clin. 2011;21(2):219-viii.
3. Kandathil A, Chamarthy M. Pulmonary vascular anatomy & anatomical variants. Cardiovasc Diagn Ther. 2018;8(3):201-207.
4. Clift PF, Cervi E. A review of thoracic aortic aneurysm disease. Echo Res Pract. 2019;7(1):R1-R10.
5. Chironi G, Orobinskaia L, Mégnien JL, et al. Early thoracic aorta enlargement in asymptomatic individuals at risk for cardiovascular disease: determinant factors and clinical implication. J Hypertens. 2010;28(10):2134-2138.
6. Mulè G, Nardi E, Morreale M, et al. The relationship between aortic root size and hypertension: an unsolved conundrum. Adv Exp Med Biol. 2017;956:427-445.
7. Standring S. Gray's anatomy: the anatomical basis of clinical practice. 41st edition. Edinburgh, New York: Elsevier; 2016:998.
8. Mohammadi S, Hedjazi A, Sajjadian M, Ghoroubi N, Mohammadi M, Erfani S. Study of the normal heart size in Northwest part of Iranian population: a cadaveric study. J Cardiovasc Thorac Res. 2016;8(3):119-125.
9. Mannan S, Khalil M, Rahman M, Ahmed MS. Measurement of different external dimensions of the heart in adult Bangladeshi cadaver. Mymensingh Med J. 2009;18(2):175-178.
10. Redheuil A, Yu WC, Mousseaux E, et al. Age-related changes in aortic arch geometry: relationship with proximal aortic function and left ventricular mass and remodeling. J Am Coll Cardiol. 2011;58(12):1262-1270.
11. McComb BL, Munden RF, Duan F, Jain AA, Tuite C, Chiles C. Normative reference values of thoracic aortic diameter in American College of Radiology Imaging Network (ACRIN 6654) arm of National Lung Screening Trial. Clin Imaging. 2016;40(5):936-943.
12. Aboulhoda BE, Ahmed RK, Awad AS. Clinically-relevant morphometric parameters and anatomical variations of the aortic arch branching pattern. Surg Radiol Anat. 2019;41(7):731-744.
13. Shin IY, Chung YG, Shin WH, Im SB, Hwang SC, Kim BT. A morphometric study on cadaveric aortic arch and its major branches in 25 korean adults: the perspective of endovascular surgery. J Korean Neurosurg Soc. 2008;44(2):78-83.
14. Chiu P, Lee HP, Venkatesh SK, Ho P. Anatomical characteristics of the thoracic aortic arch in an Asian population. Asian Cardiovasc Thorac Ann. 2013;21(2):151-159.
15. Bozlar U, Ors F, Deniz O, et al. Pulmonary artery diameters measured by multidetector-row computed tomography in healthy adults. Acta Radiol. 2007;48(10):1086-1091.
16. Truong QA, Massaro JM, Rogers IS, et al. Reference values for normal pulmonary artery dimensions by noncontrast cardiac computed tomography: the Framingham Heart Study. Circ Cardiovasc Imaging. 2012;5(1):147-154.
17. Secomb TW. Hemodynamics. Compr Physiol. 2016;6(2):975-1003.
18. Erbel R, Eggebrecht H. Aortic dimensions and the risk of dissection. Heart. 2006;92(1):137-142.
19. Saliba E, Sia Y; In collaboration with. The ascending aortic aneurysm: When to intervene?. Int J Cardiol Heart Vasc. 2015;6:91-100.
20. Lange TJ, Dornia C, Stiefel J, et al. Increased pulmonary artery diameter on chest computed tomography can predict borderline pulmonary hypertension. Pulm Circ. 2013;3(2):363-368.

turnitin aortic

by Dian Mediana

Submission date: 17-Nov-2025 07:06PM (UTC+0700)
Submission ID: 2731696111
File name: document.pdf (460.67K)
Word count: 2389
Character count: 12422

CASE REPORT
Bali Medical Journal (*Bali Med J*) 2020, Volume 9, Number 2: 416-418
P-ISSN.2089-1180, E-ISSN.2302-2914

Published by DiscoverSys

Aortic Enlargement: A Case Report of Cadaveric Heart and Great Vessels Dimensions

Mauritius Lambertus Edy Parwanto,[1*] Dian Mediana,[2] Diana Samara,[2] Magdalena Wartono,[2] Alfred Pakpahan,[3] Haryo Ganeca Widyatama[4]

ABSTRACT

Aortic enlargement is not an uncommon incidental finding with potential omission of clinical implications. During routine dissection in the middle of the thorax, there was an incidental finding of a disproportionately enlarged aorta in comparison to normal-sized heart at gross observation despite normal anatomy in local and adjacent structures. Incidental finding of aortic enlargement should not be disregarded as it might contribute to pathological processes. The use of indices could give a more comprehensive appraisal of cardiovascular system dimensions.

Keywords: aortic enlargement, heart, great vessels, dimension, cadaver.
Cite This Article: Parwanto, M.L.E., Mediana, D., Samara, D., Wartono, M., Pakpahan, A., Widyatama, H.G. 2020. Aortic Enlargement: A Case Report of Cadaveric Heart and Great Vessels Dimensions. *Bali Medical Journal* 9(2): 416-418. DOI:10.15562/bmj.v9i2.1817

[1]Department of Biology, Faculty of Medicine, Universitas Trisakti, Indonesia
[2]Department of Anatomy, Faculty of Medicine, Universitas Trisakti, Indonesia
[3]Department of Biology, Faculty of Dentistry, Universitas Trisakti, Indonesia
[4]Department of Histology, Faculty of Medicine, Universitas Trisakti, Indonesia.

*Correspondence to:
Mauritius Lambertus Edy Parwanto, Department of Biology, Faculty of Medicine, Universitas Trisakti, Jl. Kyai Tapa, Kampus B, No.260 Grogol 11440, Jakarta-Indonesia.
edyparwanto@trisakti.ac.id

Received: 2020-05-10
Accepted: 2020-06-08
Published: 2020-08-01

INTRODUCTION

The aorta serves as a main artery in the body owing to its large size and direct extension from the heart. Along its course through the thorax down to the abdomen it changes in three different orientations and is subdivided into three sections thereof, namely ascending aorta, aortic arch (AA), and descending aorta. Three vessels originating from superior convex part of the arch are brachiocephalic artery (BCA), left common carotid artery (LCCA), and left subclavian artery (LSCA) – which are collectively referred to as the great vessels. Towards the left and posterior of aorta lies another cardiac outflow tract named pulmonary artery, which bifurcates below the AA and enter each side of the lungs.[1-3]

Apart from normal anatomical variants, pathological processes resulting from early developmental errors or acquired changes later in life could lead to anomalous morphology of these vessels. Aortic enlargement is not an uncommon incidental finding with potential omission of clinical implications. Although the risk of aortic dilatation per se remains an enigma, once progression to aneurysm occurs, it could lead to acute fatal consequences.[4-6] This present study describes a rare cadaveric finding of aortic enlargement along with heart and great vessels dimensions.

CASE REPORT

During routine dissection in the middle of the thorax, there was an incidental finding of a disproportionately enlarged aorta in comparison to normal-sized heart at gross observation. The heart along with its great vessels were fixed using 10% formalin. This specimen was obtained from a fresh-frozen male Indonesian cadaver whose age at death was 36 years old.

External cardiac dimensions were presented in Figure 1. Heart length and width were 91.8 mm and 85.4 mm, respectively. Heart length index of 93.03 was calculated as the percentage of heart width/heart length.

Aortic size seemed to exceed the normal proportion compared with the heart as shown in the frontal and antero-frontal view. The whole structures of aorta including aortic root, ascending aorta, aortic arch, and descending aorta were expanded thoroughly (Figure 2).

Dimensions of the great vessels were provided in Table 1. Overall (96.95) and middle (27.08) aortic arch indices were calculated by these following two formulas, respectively: (aortic arch length/heart length*100) and (diameter of middle part of the aortic arch/length of the aortic arch*100).

DISCUSSION

Existing works of literature attempting to establish normal reference of heart and great vessels dimensions in postmortem setting were relatively scant. In the recent *Gray's anatomy* textbook it was cited that the average adult heart length and transverse diameter were 12 cm and 8-9 cm, respectively.[7] A large scale cadaveric study on normal heart size involving 550 cadavers of Iranian population revealed a wider reference range of heart length (11.41±2.15 cm) and width (8.21±4.38 cm). Specific mean heart length (11.89±1.60 cm) and width (8.98±7.17 cm) for matching age group (30-39 years) were provided

Table 1 Dimensions of the great arteries

Parameters	Measurement results (mm)
Length of AA	89.0
External diameter of proximal BCA	15.2
External diameter of proximal PA	28.0
Diameter of middle AA	24.1
Diameter of distal AA	17.5
External diameter of proximal LCCA	7.9
Internal diameter of proximal LCCA	6.0
External diameter of proximal LSCA	11.7
Internal diameter of proximal LSCA	9.5

AA: aortic arch; BCA: brachiocephalic artery; LCCA: left common carotid artery; LSCA: left subclavian artery; PA: pulmonary artery.

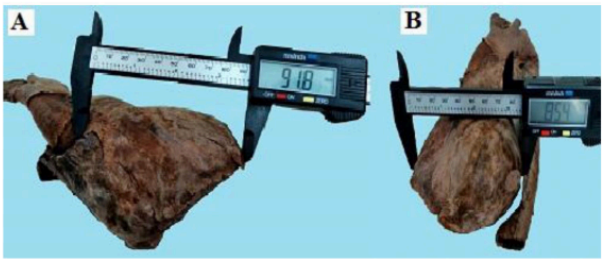

Figure 1 External cardiac dimensions. (A) Heart length measured 91.8 mm. (B) Heart width measured 85.4 mm

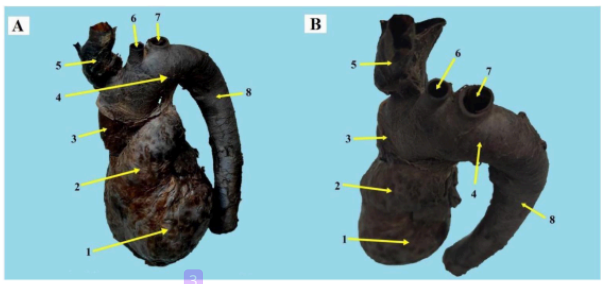

Figure 2 Photograph of the heart with surrounding great vessels. (A) Frontal view. (B) Antero-frontal view. 1, ventricle; 2, atrium; 3, ascending aorta; 4, aortic arch; 5, ascending aorta; 6, left common carotid artery; 7, left subclavian artery; 8, descending thoracic aorta

for more accurate comparison with the current study.[8] Former similar study in adult Bangladeshi decedents further specified the mean length and width for each gender. Male mean heart length (10.5±0.62 cm) and width (8.51±0.61) were more prominent than the female counterpart.[9] Heart width in current study was well within aforementioned reference ranges, while the length was below all the references.

The previous study by Redheuil et al. involving aortic arch length measurement was done using magnetic resonance imaging on a general population study sample who were free of overt cardiovascular disease. Reported mean aortic arch length for male was 122±21 mm. Despite its original aim in studying age-related changes in aortic arch geometry, the result was deemed comparable as the male patients had a mean age of 45±15 years.[10] Two other studies assessed aortic arch diameter similarly using computed tomography (CT) in both living cohort and cadavers. American College of Radiology aimed to establish normative reference values for aortic diameter as a part of a trial (National Lung Screening Trial) which include lung cancer patients. The mean diameter in axial (2.78±0.29 cm) and sagittal oblique (2.73±0.28 cm) CT was obtained.[11] An anatomical study by Aboulhoda et al. in ten adult Egyptian cadavers found mean outer aortic arch diameter of 33.83±4.03 mm proximally and 22.06±2.77 mm distally.[12] Preceding absolute measurement parameters of aortic arch were proven to be larger than that of this decedent, however we highlight the importance to take relative measurement as indices into account.

In an attempt to construct a comprehensive comparison of heart and great vessels dimensions, indices value intervals were generated from the combination of available age and gender specified normal reference ranges. Based on similar studies[8,9] the range of heart length (9.88-13.49 cm) and width (7.9-9.12 cm) were obtained, yielding heart length index value of 58.56-92.31. Additional precaution by truncating standard deviation value was taken when interpreting age-specific heart width from previous study as the range was considerably wide. Similarly, aortic arc length range (10.1-14.3 cm) extracted from the study by Redheuil et al.[10] resulted in overall aortic arch index value of 74.87-144.74. Interval range for the middle aortic arch index of 17.13-31.09 was derived from two prior studies.[11-12] Indices from this study were greater than secondarily derived reference values of past studies.

A cadaveric investigation of great vessels morphology in Korean adults investigated mean internal diameters of BCA (18.3 ± 7.0 mm), LCCA (9.8 ± 1.9), and LSCA (10.6 ± 2.4).[13] Measurements of the outer diameter of BCA (15.7±7.42 mm), LCCA (11.42±4.72 mm), and LSCA (14.02±6.8 mm) were also found by Aboulhoda et al.[12] Mean external diameters of BCA (18.0±3.8 mm), LCCA (12.6±2.7 mm), and LSCA (14.1±2.5 mm) were measured by CT aortograms in over a hundred of Asian patients without previous open surgery or endovascular treatment of the thoracic aorta.[14] Comparable internal dan external diameters were found in this report except for smaller internal LCCA diameter.

In contrast to other dimensions of interest, pulmonary artery diameter was more rigorously researched and therefore had fixed normative value established. Both studies covered in this topic used CT as their imaging modality, but the main difference lies in the study population recruited. An earlier study in healthy adults showed mean PA diameter of 24.0±2.8 mm without significant gender difference.[15] While later study as a part of community-based Framingham Heart Study revealed comparable diameter (25.1±2.8 mm), more straightforward gender-specific normative reference was determined for men (29 mm) and women (27 mm).[16] These results confirmed a normal PA size in this case.

Cardiovascular system function on hemodynamic maintenance is a resultant of both cardiac and vessels integration.[17] Great deal of effort was put on working towards determining certain predictive vessel diameter cut-off value in relation to risk prognostication and optimal management of relevant diseases.[18-20] We propose the application of indices that would better reflect cardiovascular system dimensions as a whole rather than separately.

CONCLUSION

Incidental finding of aortic enlargement should not be disregarded as it might contribute to pathological processes. The use of indices could give a more comprehensive appraisal of cardiovascular system dimensions.

ACKNOWLEDGEMENTS

We would like to thank Mr Dian and Heru for their support in the cadaver photoshoot.

CONFLICTS OF INTEREST

The authors declare that they have no competing interests.

FUNDING

All authors have no support or funding to report.

AUTHORS CONTRIBUTIONS

Conceptualization: MLEP. Data acquisition: MLEP, DM, DS and MW. Data analysis or interpretation: all authors. Drafting of the manuscript: MLEP, DM, HGW. Critical revision of the manuscript: DM, DS, MW, AP, HGW. Approval of the final version of the manuscript: all authors.

REFERENCES

1. Komutrattananont P, Mahakkanukrauh P, Das S. Morphology of the human aorta and age-related changes: anatomical facts. Anat Cell Biol. 2019;52(2):109-114.
2. Dagenais F. Anatomy of the thoracic aorta and of its branches. Thorac Surg Clin. 2011;21(2):219-viii.
3. Kandathil A, Chamarthy M. Pulmonary vascular anatomy & anatomical variants. Cardiovasc Diagn Ther. 2018;8(3):201-207.
4. Clift PF, Cervi E. A review of thoracic aortic aneurysm disease. Echo Res Pract. 2019;7(1):R1-R10.
5. Chironi G, Orobinskaia L, Mégnien JL, et al. Early thoracic aorta enlargement in asymptomatic individuals at risk for cardiovascular disease: determinant factors and clinical implication. J Hypertens. 2010;28(10):2134-2138.
6. Mulè G, Nardi E, Morreale M, et al. The relationship between aortic root size and hypertension: an unsolved conundrum. Adv Exp Med Biol. 2017;956:427-445.
7. Standring S. Gray's anatomy: the anatomical basis of clinical practice. 41st edition. Edinburgh, New York: Elsevier; 2016:998.
8. Mohammadi S, Hedjazi A, Sajjadian M, Ghoroubi N, Mohammadi M, Erfani S. Study of the normal heart size in Northwest part of Iranian population: a cadaveric study. J Cardiovasc Thorac Res. 2016;8(3):119-125.
9. Mannan S, Khalil M, Rahman M, Ahmed MS. Measurement of different external dimensions of the heart in adult Bangladeshi cadaver. Mymensingh Med J. 2009;18(2):175-178.
10. Redheuil A, Yu WC, Mousseaux E, et al. Age-related changes in aortic arch geometry: relationship with proximal aortic function and left ventricular mass and remodeling. J Am Coll Cardiol. 2011;58(12):1262-1270.
11. McComb BL, Munden RF, Duan F, Jain AA, Tuite C, Chiles C. Normative reference values of thoracic aortic diameter in American College of Radiology Imaging Network (ACRIN 6654) arm of National Lung Screening Trial. Clin Imaging. 2016;40(5):936-943.
12. Aboulhoda BE, Ahmed RK, Awad AS. Clinically-relevant morphometric parameters and anatomical variations of the aortic arch branching pattern. Surg Radiol Anat. 2019;41(7):731-744.
13. Shin IY, Chung YG, Shin WH, Im SB, Hwang SC, Kim BT. A morphometric study on cadaveric aortic arch and its major branches in 25 korean adults: the perspective of endovascular surgery. J Korean Neurosurg Soc. 2008;44(2):78-83.
14. Chiu P, Lee HP, Venkatesh SK, Ho P. Anatomical characteristics of the thoracic aortic arch in an Asian population. Asian Cardiovasc Thorac Ann. 2013;21(2):151-159.
15. Bozlar U, Ors F, Deniz O, et al. Pulmonary artery diameters measured by multidetector-row computed tomography in healthy adults. Acta Radiol. 2007;48(10):1086-1091.
16. Truong QA, Massaro JM, Rogers IS, et al. Reference values for normal pulmonary artery dimensions by noncontrast cardiac computed tomography: the Framingham Heart Study. Circ Cardiovasc Imaging. 2012;5(1):147-154.
17. Secomb TW. Hemodynamics. Compr Physiol. 2016;6(2):975-1003.
18. Erbel R, Eggebrecht H. Aortic dimensions and the risk of dissection. Heart. 2006;92(1):137-142.
19. Saliba E, Sia Y; In collaboration with. The ascending aortic aneurysm: When to intervene?. Int J Cardiol Heart Vasc. 2015;6:91-100.
20. Lange TJ, Dornia C, Stiefel J, et al. Increased pulmonary artery diameter on chest computed tomography can predict borderline pulmonary hypertension. Pulm Circ. 2013;3(2):363-368.

turnitin aortic

ORIGINALITY REPORT

14%	12%	8%	7%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	Submitted to SDM Universitas Gadjah Mada Student Paper	2%
2	www.walshmedicalmedia.com Internet Source	2%
3	"Echocardiography in Pediatric and Congenital Heart Disease", Wiley, 2021 Publication	2%
4	www.researchsquare.com Internet Source	1%
5	Dariusz Nowak, Hanna Kozłowska, Anna Żurada, Jerzy Gielecki. "Diameter of the ductus arteriosus as a predictor of patent ductus arteriosus (PDA)", Open Medicine, 2011 Publication	1%
6	journals.viamedica.pl Internet Source	1%
7	www.frontiersin.org Internet Source	1%
8	Submitted to Sriwijaya University Student Paper	1%
9	pdfs.semanticscholar.org Internet Source	1%
10	www.ijars.net Internet Source	

		1 %
11	Chiu, P., H. P. Lee, S. K. Venkatesh, and P. Ho. "Anatomical characteristics of the thoracic aortic arch in an Asian population", Asian Cardiovascular and Thoracic Annals, 2013. Publication	1 %
12	www.ctsurgery.com Internet Source	1 %

Exclude quotes	On	Exclude matches	< 10 words
Exclude bibliography	On		