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Echocardiographic Dimensions and Selected Hemato-Biochemical Constituents of Clinically Normal Rahmany Sheep in Egypt

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ECHOCARDIOGRAPHIC and the related hemato-biochemical reference measurements are not reported in Rahmany sheep in Egypt before. Our goal is to record the normal echocardiographic dimensions using M-mode and Doppler techniques in such breed of sheep in Egypt along with related selected hemato-biochemical values. In 25 clinically healthy female Rahmany sheep aged between 4 and 5 years with a weight of 70-80 kg, selected to be non pregnant and non lactating, echocardiography was conducted for wake sheep in the lateral recumbency. M-mode echocardiography parameters include Left ventricle end-diastolic and end-systolic diameters, interventricular septal thickness in diastole and systole, left ventricle free wall thickness in diastole and systole, heart rate, end-diastolic volume, end-systolic volume, cardiac output, stroke volume, fraction shortening, and ejection fraction. Aortic root diameter, left atrium diameter, and the left atrium / aortic diameter ratio were recorded. Doppler echocardiography was used for the assessment of the aortic and pulmonary artery blood flow velocities: peak velocity (PV) and pressure gradient (PG). The Left ventricle diastolic parameters including early (E_{max}) and late (A_{max}) velocities and, E_{max}/A_{max} ratio, were obtained. Whole blood and serum samples for selected hematological and serum biochemical constituents include protein profile, total bilirubin, glucose, urea nitrogen, creatinine, alanine aminotransferase, aspartate aminotransferase, gamma-glutamyl transferase, cardiac troponin I, potassium, sodium, chloride, calcium, magnesium, and phosphorus. Differences were reported in Rahmany sheep when compared to other breeds of sheep.

In conclusion, Echocardiographic, and hemato-biochemical measurements in Rahmany sheep can provide normal reference ranges that could be useful in the accurate detection of cardiac structural and functional abnormalities to help in the diagnosis of heart diseases.

Keywords: Biochemistry, Doppler, Egyptian Rahmany sheep, Hematology, M-mode echocardiography.

Introduction

Hematological profile assessment helps in investigation of the presence of many metabolites and other body constituents. It is essential in the assessment of the healthy status of the animal include its nutritional, physiological, and also, pathological status. It also aids in distinguishing the normal state from the abnormal state [1].

Echocardiography is considered a quick, non-invasive, and accurate method for clinical diagnosis, which is used widely for the determination of the structure and function of heart chambers in different animal species [2].

A lot of papers have studied the lambs 'cardiac anatomic structures and the time indices [3]. While others have studied the echocardiography of the

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heart from the different aspects of performance in sheep [4]. Echocardiography is a clinical method in ovine and caprine, although a small acoustic window makes it hard to attain some of the images in some animal species [5, 6].

Cardiac abnormalities in sheep are less frequently diagnosed as it is relatively resistant to cardiac diseases, silent or atypical clinical symptoms, inadequate detection for these abnormalities, and lack of normal values of the cardiac measurements. Endocarditis is considered one of the most frequent cardiac pathologies which can be seen in different animal species including sheep [7] however, there is a shortage of papers discussed this disease. Also, because of the shortages in the cardiovascular examination, congenital cardiac defects such as tetralogy of Fallot, patent ductus arteriosus, and ventricular septal defects which are frequently diagnosed in humans, horses, and pet animals, are rarely diagnosed and recorded in sheep [2].

Sheep are considered an appropriate animal model because it is a calm, slow growth and easily housed animal. In addition, the ovine heart has dimensional parameters which are remarkable resemblances to the human heart [8-11].

The Rahmany sheep is the most common Egyptian medium-sized, with short fat-tailed breeds. It is mainly used for milk and meat production. According to our information, echocardiographic parameters in clinically normal Rahmany sheep have not been discussed before. Therefore, our goal was to record reference values of normal echocardiographic measurements and heart function using M-mode, and Doppler methods in such breed of sheep along with normal related hematological and serum biochemical constituents.

Material and Methods

Animals

The questionnaire and methodology for this study was approved by the Institutional Animal Care and Use committee of the Cairo University (IACUC) (Ethics approval number: Vet CU 2305 2022471).

Twenty-five adults female Rahmany sheep, 4-5 years old, and 70-80 kg body weight (BW), selected to be non pregnant and non lactating were included in our study. Sheep were housed in a special barn that belongs to faculty of veterinary medicine, Cairo University, Egypt. Where they fed on pelleted feed supplemented with trace minerals (mineral mixture) and wheat straw as a basic diet twice daily and received water ad libitum. None of the sheep received any medications during this period. The sheep were adapted to the hospital for long period before joining the study.

Full physical and clinical examinations were performed and animals were considered physically fit upon the examinations. In all sheep, findings of clinical, hemato-biochemical and echocardiographic examinations were recorded and compared with records of other studies [12].

Conventional Echocardiography

The echocardiography was conducted for wake sheep to calculate all echocardiographic reference data. The mean of the calculated dimensions was attained from 5 frequent cardiac cycles. The examined animals were restraint in the lateral recumbency with holding the both forelegs anteriorly while conducting the echocardiographic examination. The right and left precordial areas were clipped, shaved, and coated with an ultrasonic gel supplied with a sector probe of 2-4 MHz and an electrocardiographic monitoring system was used (EDAN AX8, China). The calculated cardiac dimensions and image positioning were done according to the guidelines of the American Society of Echocardiography [13].

Complete conventional M-mode and Doppler echocardiography from the standard right and left parasternal views was achieved on all animals. Firstly, the right parasternal long axis (RPLAV) 4-chamber and 5-chamber views were imagined. Then the M-mode of the short-axis v**ie**w was switched on at the papillary muscle level to image the measurements of the LV functions. It comprises LV end-systolic and end-diastolic diameters (LVIDs, LVIDd), interventricular septal thickness in systole and diastole (IVSTs, IVSTd), LV free wall thickness in systole and diastole (LVPWs, LVPWd), heart rate (HR), end diastolic volume (EDV), end systolic volume (ESV), cardiac output (CO), stroke volume (SV), fraction shortening (FS), and ejection fraction (EF). Then aortic root diameter (AoR), left atrium diameter (LAD), and the left atrium/ aortic diameter ratio (LAD/AoR) were also measured [14] .The findings were shown in Fig. (1, 2)

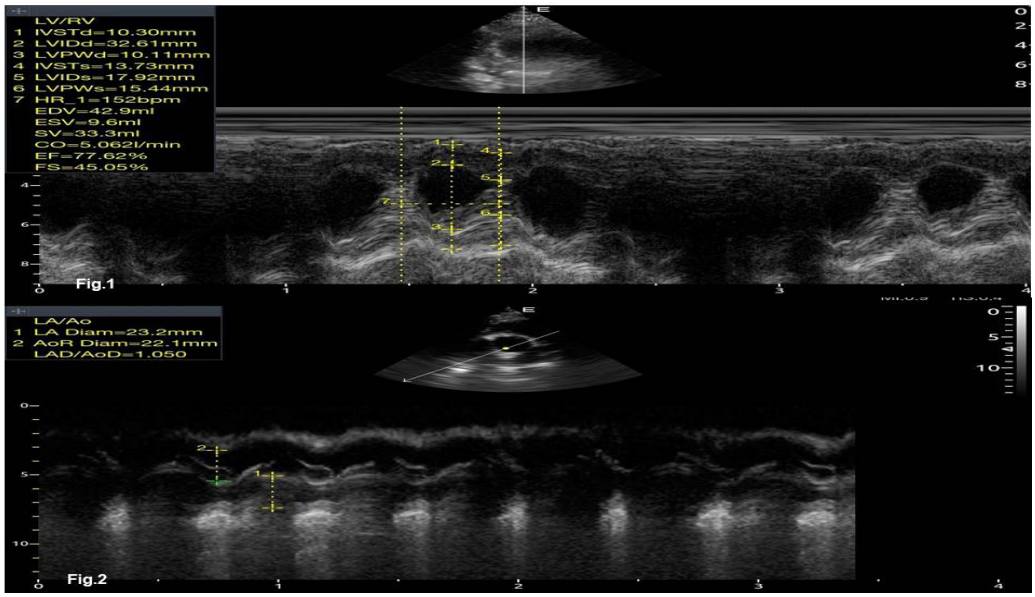

Fig. 1 , 2. Represent M-mode of the short-axis view at the papillary muscle level to record the measurements of the LV functions. This includes LV end-diastolic and end-systolic diameters (LVIDd, LVIDs), interventricular septal thickness in diastole and systole (IVSTd, IVSTs), LV free wall thickness in diastole and systole (LVPWd, LVPWs), heart rate (HR), end diastolic volume (EDV), end systolic volume (ESV), cardiac output (CO), stroke volume (SV), fraction shortening (FS), and ejection fraction (EF). Then aortic root diameter (AoR), left atrium diameter (LAD), and the left atrium/ aortic diameter ratio (LAD/AoR) were reported.

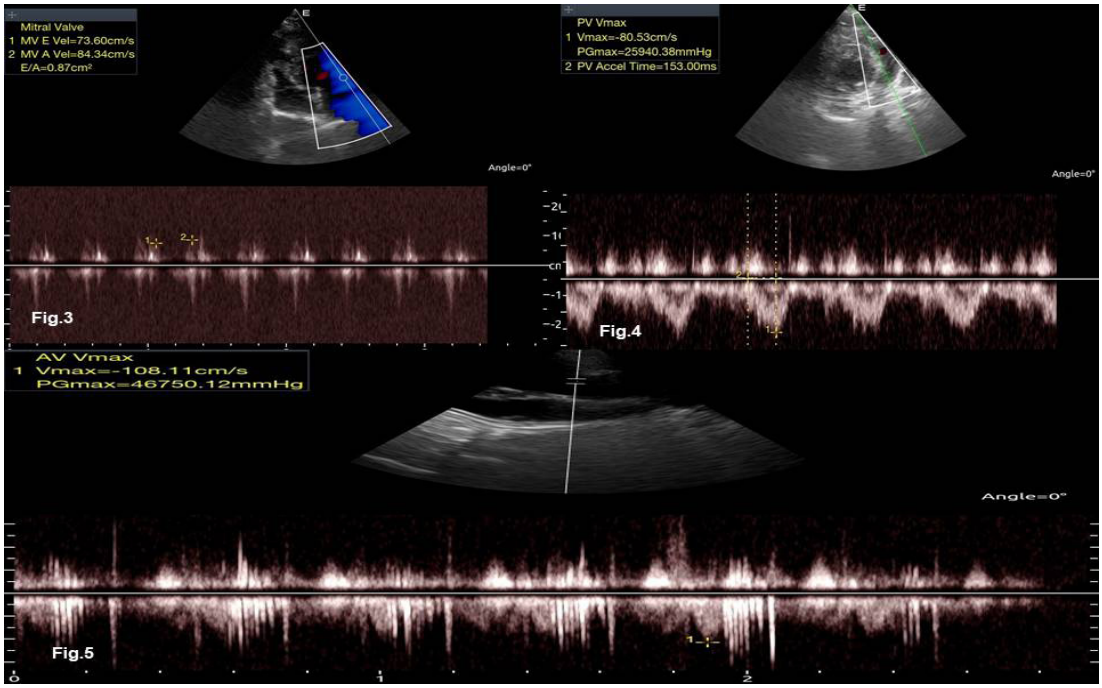

Fig. 3, 4 , 5. Represent Doppler echocardiography of mitral, pulmonary, and aortic valves blood flow respectively. From the left apical four-chamber view, the LV diastolic parameters including early (E_{max}) and late (A_{max}) velocities and, E_{max}/A_{max} ratio, were obtained from the trans-mitral flow profile using Doppler. Also, the transducer was slightly moved anteriorly to obtain the left apical 5-chamber view for Doppler evaluation of the trans-aortic blood flow. Doppler parameters of the pulmonary and aortic flow have been addressed: peak velocity (PV) and pressure gradient (PG).

Doppler echocardiography

Also, the Doppler echocardiography was used for calculation of the blood flow of pulmonary artery. Then the animals ware repositioned to get the left side echocardiography. Turned into the left apical four-chamber view, the LV diastolic parameters including early (E_{max}) and late (A_{max}) velocities and, E_{max}/A_{max} ratio, were attained from the trans-mitral flow profile using Doppler. Also, the transducer was moved anteriorly to get the left apical 5-chamber view for the evaluation of Doppler of the trans-aortic blood flow.

The pulmonary and aortic flow velocities have been calculated as the following: peak velocity (PV) and pressure gradient (PG) according to some literature [15, 16] as shown in Fig. (3, 4, 5)

Whole Blood and Serum sampling and examinations

Blood samples were collected from the jugular vein and divided into three portions, 1st part was transmitted to an EDTA test tube, which was utilized to perform hematological profile. Total erythrocyte count (TEC), hemoglobin content (Hb), total leukocyte count (TLC) and differential leukocytic count (DLC) were detected using Auto-Hematological Analyzer (Mindray BC-2800). While the 2nd portion was transmitted to a sodium citrate test tube and was inverted many times for mixing the blood with sodium citrate to measure fibrinogen. The 3rd part transferred to a plain test tube and by centrifugation at 3000 rpm for 10 min to obtain serum. The obtained serum was used to measure the selected blood biochemical constituents including protein profile, total bilirubin, glucose, creatinine, blood urea nitrogen, alanine aminotransferase (ALT), aspartate aminotransferase (AST), and gamma glutamyl transferase (GGT). Also, serum electrolytes and minerals as potassium, sodium, chloride, calcium, magnesium and phosphorus using commercial kits (PZ CORMAY S.A., Poland) with Auto Chemistry Analyzer (Model Polimak M10/2, Italy), and measurement of cardiac troponin I (cTnI) using sheep cardiac Troponin I ELISA Kit (My biosource, USA).

Finally, the attained data were analyzed using the Independent-Samples T-test, the SPSS software package for Windows Ver. 20.0 (SPSS Inc., Chicago, IL, USA) and tabulated as mean value ± SE for hemato-biochemical analysis and mean value ± SD for echocardiographic dimensions. Echocardiography measurements were taken by a specialized observer with seven years of experience in veterinary Echocardiography and were calculated by using the device built-in software.

Results

Our results showed Hb content, PCV percent, RBCs count, platelets count, MCV, MCH concentrations and WBCs counts were 10.48 ± 0.47, 21.68 ± 1.48, 7.12 ± 0.24, 487.17 ± 11.12, 30.89 ± 2.44, 12.22 ± 1.67and 11.01 ± 0.68, respectively in Rahmany sheep as shown in Table 1.

TABLE 1. Hematological profile of normal Egyptian Rahmany sheep.

Parameters	Sheep (n = 25) Mean± SE
Hemoglobin (gm %)	10.48 ± 0.47
RBCs (10^6/mm^3)	7.12 ± 0.24
PCV %	21.68 ± 1.48
Platelets (10^3/mm^3)	487.17 ± 11.12
MCV (fl)	30.89 ± 2.44
MCH (pg)	12.22 ± 1.67
MCHC (g %)	35.16 ± 0.29
WBCs (10^3/mm^3)	11.01 ± 0.68
Neutrophils (10^3/mm^3)	4.25 ± 0.59
Lymphocytes (10^3/mm^3)	5.25 ± 0.52
Monocytes (10^3/mm^3)	0.87 ± 0.13
Eosinophil (10^3/mm^3)	0.41 ± 0.09
Basophils (10^3/mm^3)	0.00 ± 0.00

While biological profile of cardiac damage indicator including cardiac troponin were negative. The results of metabolites showed, total bilirubin (mg/dl), glucose (mg/dl), urea nitrogen (mg/dl) and creatinine (mg/dl) were 0.37± 0.04, 72.07 ± 2.00, 38.11 ± 1.41 and 0.74 ± 0.05 respectively. While the results of the enzymatic activities showed that Alanine aminotransferase (ALT) (mg/dL); aspartate aminotransferase (AST) (mg/dL) and gamma-glutamyl transferase (GGT) (mg/dL) were 14.37 ± 0.49, 81.50 ± 5.03 and 54.75 ± 4.09 respectively. Protein profile were measured showing that total protein(g/dL), albumin(g/dL), globulin(g/dL), A/G ratio and fibrinogen (mg/dL) values were 7.45 ± 0.19, 3.39 ± 0.06, 4.06 ± 0.15, 0.83 ± 0.02, and 249.91 ± 12.92, respectively. Electrolytes include, Potassium (mEq/L), Sodium (mEq/L) and Chloride (mEq/L) were 5.12 ± 0.13, 151.00 ± 1.63 and 113.00 ± 1.19, respectively. Finally, the results of minerals showed, calcium (mg/dl), magnesium (mg/dl) and phosphorus (mg/dl) were 9.34 ± 0.21, 3.05 ± 0.16 and 8.13 ± 0.29 respectively in Rahmany sheep as detailed in Table 2.

TABLE 2. Biological profile of normal Egyptian Rahmany sheep.

Parameters	Sheep (n = 25) Mean± SE
Cardiac damage indicator	
cTnI (ng/ml)	Negative
Metabolites	
Total bilirubin (mg/dL)	0.37± 0.04
Glucose (mg/dL)	72.07 ± 2.00
Urea nitrogen (mg/dL)	38.11 ± 1.41
Creatinine (mg/dL)	0.74 ± 0.05
Enzymes	
ALT(mg/dL)	14.37 ± 0.49
AST (mg/dL)	81.50 ± 5.03
GGT (mg/dL)	54.75 ± 4.09
Proteins	
Total protein (g/dL)	7.45 ± 0.19
Albumin (g/dL)	3.39 ± 0.06
Globulin (g/dL)	4.06 ± 0.15
A/G ratio	0.83 ± 0.02
Fibrinogen (mg/dL)	249.91 ± 12.92
Electrolytes	
Potassium (mEq/L)	5.12 ± 0.13
Sodium (mEq/L)	151.00 ± 1.63
Chloride (mEq/L)	113.00 ± 1.19
Minerals	
Calcium (mg/dL)	9.34 ± 0.21
Magnesium (mg/dL)	3.05 ± 0.16
Phosphorus (mg/dL)	8.13 ± 0.29

All of the studied sheep showed normal general clinical examination profile, vital signs cardiac sounds and rate during our study and the echocardiographic process. The mean heart rate during the study was 127.75 ± 4.82 in the Rahmany sheep. M-mode echocardiographic measurements are summarized in Tables 3 and 4.

TABLE 3. Mean ± SD value of the M-mode echocardiographic parameters of normal Egyptian Rahmany sheep.

Parameters	Sheep (n = 25) Mean± SD
IVSTd (cm)	0.94 ± 00.9
IVSTs (cm)	1.37 ± 0.22
LVIDd (cm)	3.97 ± 0.67
LVIDs (cm)	1.86 ± 0.55
LVPWd (cm)	1.080 ± 0.23
LVPWs (cm)	1.865 ± 0.55
HR (bpm)	127.75 ± 16.7
EDV (ml)	72.68 ± 27.5
ESV (ml)	13.79 ± 6.7
SV (ml)	58.89 ± 24.3
CO (l/min)	7.63 ± 3.8
EF %	80.52 ±6.4
FS %	49.20 ±7.1
LAD (cm)	3.31 ± 0.32
AoR (cm)	2.12 ± 0.25
LAD/AoR	1.59 ± 0.03

IVSTd: Interventricular septal thickness at end-diastole; IVSTs: Interventricular septal thickness at end-systole LVIDd: Left ventricular internal diameter at end-diastole; LVIDs: Left ventricular internal diameter at end-systole; LVPWd: Left ventricular posterior wall thickness at end-diastole; LVPWs: Left ventricular posterior wall thickness at end-systole; HR: Heart rate; EDV: End-diastolic volume; ESV: End-systolic volume; SV: Stroke volume; CO: Cardiac output; EF: Ejection fraction; FS: Fractional shortening; LAD: left atrial diameter; AoR: Aortic root diameter; LAD/AoR: Ratio of left atrial diameter to aortic root diameter at end- diastole.

TABLE 4. Mean ± SD value of Doppler echocardiography of normal Egyptian Rahmany sheep.

Parameters	MV E_{max} (m/s)	MV A_{max} (m/s)	E_{max}/A_{max} (m^2)	PV (V_{max}) (m/s)	PV (PG_{max}) (mmHg)	AV (V_{max}) (m/s)	AV (PG_{max}) (mmHg)
Sheep (n = 25) Mean± SD	0.68 ± 0.13	0.85 ± 0.14	0.82 ± 0.25	1.04± 0.13	4.41± 1.16	1.10 ± 0.17	4.97 ± 1.55

MV E_{max}: Mitral valve E wave velocity; MV A_{max}: Mitral valve A wave velocity; E_{max}/A_{max}; Ratio between E and A waves to locate maximal flow velocity; PV (V_{max}): Pulmonary valve maximal blood velocity; PV (PG_{max}): Pulmonary valve maximal pressure gradient; AV(V_{max}); Aortic valve maximal blood velocity; AV(PG_{max}) Aortic valve maximal pressure gradient.

Discussion

Blood hematology, and serum bio-chemical values are different, dependable, and helpful in diagnosis and prognosis of animal disease, and animal health status as deviations in these references are signs of pathological reactions so presence of a basic data on the epidemiology of farm animals to reduce economic loss, improve management process, estimation of nutrition and improving health management process [17].

The hematological profile is helping in detecting the deviation from normal health status, which may not be prominent during normal clinical examination, but affects the health of the animal [18].

According to our results Hb content, PCV value, RBCs count, platelets count, MCV, MCH concentrations and WBCs counts were 10.48 ± 0.47, 21.68 ± 1.48, 7.12 ± 0.24, 487.17 ± 11.12, 30.89 ± 2.44, 12.22 ± 1.67and 11.01 ± 0.68 respectively in Egyptian Rahmany sheep.

PCV % of 30 and (Hb) (g/%) of 9.41 for West Africa Dwarf rams (WAD) are within the normal range as described by some researchers[19]. A low iron intake may be the possible cause of detected lower PCV and Hb values in WAD sheep as discussed by Oyeyemi and Ajani [20]. As reported by Bello and Tsado [21] hemoglobin values within normal physiological range indicates that a high quality dietary proteins were used.

The reference values for hematological parameters of sheep as the following: PCV (%) 24 – 45, Hb (g/dl) 8 – 16, MCV (fl), 23 – 48, MCH (pg) 8 – 12, MCHC (g/dl) 31 – 38 and WBCs ($x10^3/mm^3$) 4 – 12 and stated that the average values are different from many sources as reported by some researchers [22, 23]. Also, other investigators [24] reported the following ranges of values for hematological parameters for different limes of Awassi sheep: PCV (%)28 – 31, Hb (g/dl) 10.4 – 10.5, RBCs (x $10^6/mm^3$) 8.9 – 9.3, MCV (fl) 30 – 33, MCH (pg) 11 – 12, MCHC (g/dl) 33.5 – 46 and WBCs ($x10^3/mm^3$) 4.3 – 7.4 and stated that they were within normal ranges for sheep. Hematological values of different breeds of sheep as reported by [21, 24, 25, 26] PCV values of 22.9 – 29.4, 20.10 - 48.00 and 27.45 – 29.13 in Yankasa rams, Afec-Awassi sheep and WAD sheep respectively, Hb (g/dl) were 8.4 – 9.7, and 8.15 – 10.7 in Yankasa rams, and WAD sheep respectively while WBCs ($x10^9/l$) were 3.2 – 15.80, and 7.0 – 12.9 in Afec-Awassi sheep, and Yankasa rams respectively. There is a wide range of values recorded. This may be due to difference in sex, age, strain, and breed, sampling methods and testing practice as reported by Etim [1].

Indices for RBCs evaluation includes, hemoglobin, packed cell volume, and mean corpuscular hemoglobin are important in the detection of anemia [23, 27]. They also useful to determine the capacity of the bone marrow in producing red blood cells as mentioned by some researchers [28, 29]. Concentration of mean corpuscular hemoglobin and mean corpuscular hemoglobin indices show blood level disorders. Anemia is indicated by a low level, while a high level indicates a normal condition as reported by other researchers [30].

Biological profile of Egyptian Rahmany sheep showed a wide range of values, this may be due to differences in species, age, and sex, breed, sampling methods and testing procedure. In our study we collect serum from sheep for estimation of some biochemical constituents including cardiac damage indicator, metabolites, enzymes, proteins, electrolytes and minerals.

It is highlighted that cTnI is a powerful sensitive biomarker in detecting heart muscle damage in sheep. Concentrations of serum and plasma cTnI increase significantly in myocardial damage diseases in sheep with different causes, and cTnI is a significant and sensitive diagnostic and prognostic marker for the heart diseases as said by some scientists [31, 32]. According to our result, cTnI was negative in serum samples from apparently healthy sheep due to absence of any disease which confirmed by echocardiography finding.

According to results of our study, total bilirubin (mg/dl), glucose (mg/dl), urea nitrogen (mg/dl) and creatinine (mg/dl) were 0.37± 0.04, 72.07 ± 2.00, 38.11 ± 1.41 and 0.74 ± 0.05 respectively in Egyptian Rahmany sheep. Urea nitrogen; creatinine and glucose levels were 15±4, 0.5±0.3 and 68±9 respectively in Awassi sheep as found by others [33]. The normal levels of total bilirubin (mg/dl) and glucose (mg/dl) were 0.185±0.01 and 74.75±14.93 respectively in apparently healthy sheep as reported by Satish et al. [34]. While the normal range of total bilirubin (mg/dl), glucose (mg/dl), urea nitrogen (mg/dl) and creatinine (mg/dl) were 0.1-0.5, 50-80, 8.0-20 and 1.2-1.9 respectively in ovine species as stated by many authors[35, 36].

The present study showed that Alanine aminotransferase (ALT) (mg/dL); aspartate aminotransferase (AST) (mg/dL) and gamma-glutamyl transferase (GGT) (mg/dL) were 14.37 ± 0.49, 81.50 ± 5.03 and 54.75 ± 4.09 respectively in Egyptian Rahmany sheep. AST (U/ml) and GGT (U/ml) were 55±10 and 31±12 respectively in Awassi sheep as listed by [33]. Whereas, [34] reported that normal levels of ALT (IU/L) and AST (IU/L) were 18.75±1.49 and 66.00±2.34 respectively in apparently healthy sheep. Also, [35, 36] stated that normal range of AST (IU/L) and GGT (IU/L) were 60-280 and 40-79 respectively in ovine species.

In our work we found that total protein (g/dl), albumin (g/dl), globulin (g/dl), A/G ratio and fibrinogen (mg/dl) were 7.45 ± 0.19, 3.39 ± 0.06, 4.06 ± 0.15, 0.83 ± 0.02 and 249.91 ± 12.92 respectively in Egyptian Rahmany sheep. The total protein (g/dl) and Albumin (g/dl) were 6.2±0.5 and 2.3±0.5 respectively in Awassi sheep as listed by Bani Ismail et al.[33]. Whereas, [34] reported that normal levels of Total protein (g%) and Albumin (g%) were 5.91±0.03 and 2.89±0.02 respectively in apparently healthy sheep. The normal range of Total proteins (g/dL), Albumin (g/dL) and Globulins (g/dL) were 6.0-7.9, 2.4-3.0 and 3.5-5.7 respectively in ovine species as reported by others [35, 36].

According to our results, Potassium (mEq/L), Sodium (mEq/L) and Chloride (mEq/L) were 5.12 ± 0.13, 151.00 ± 1.63 and 113.00 ± 1.19 respectively which agreed with some authors [35, 36] also, they stated that normal range of Sodium (mmol/L), Potassium (mmol/L) and Chlorine (mmol/L) were 139-152, 3.9-5.4 and 95-103 respectively in ovine species.

According to our findings, calcium (mg/dl), magnesium (mg/dl) and phosphorus (mg/dl) were 9.34 ± 0.21, 3.05 ± 0.16 and 8.13 ± 0.29 respectively. The normal range of Calcium (mg/dL), Phosphorus (mg/dL) and Magnesium (mg/dL) were 11.5-12.8, 5.0-7.3 and 2.2-2.8 respectively in ovine species as mentioned by some researchers[35, 36].

Echocardiography

Reference values and mean ± SD for heart internal structure are demonstrated in Table (3, and 4). This study provides an excellent dimensional measurement values that can be conducted from M-Mode, and Doppler echocardiography in Egyptian Rahmany sheep, which have not previously been reported. Determination of internal cardiac dimensions for adult sheep should improve detection, diagnosis and evaluation of cardiac disease in sheep [37].

Our study showed differences in ventricular dimensions of Rahmany sheep when compared to previous studies by Hallowell et al. and Roustaei et al. [2, 37] who reported that Interventricular septal thickness at end-diastole (1.19 0.81 ,١،٥± 0.14 ±), Interventricular septal thickness at end-systole (1.55 ±1.8, 1.40 ± 0.18), Left ventricular internal diameter at end-diastole (4.42 ± 5.4, 3.74 ± 0.30), Left ventricular internal diameter at end-systole (2.62 ± 3.5, 1.76 ± 0.27), Left ventricular posterior wall thickness at end-diastole (0.99 ± 1.4, 0.74 ± 0.12), Left ventricular posterior wall thickness at end-systole (1.50 ± 2.8, 1.40 ± 0.27), Heart rate (84.3± 5.4, 89.52 ±12.04), End-diastolic volume (Not reported, 60.38 ±11.39), End-systolic volume (Not reported, 9.58 ± 3.95), Stroke volume (Not reported, 55.13 ±14.87), Cardiac output (Not reported, 4.77 ± 1.06), Ejection fraction (76.9 ± 4.9, 80.24 ±12.21), Fractional shortening (40.2 ± 4.8, 53.62 ± 5.09), Left atrial diameter (4.59 ± ٨،٤, 3.47 ± 0.28), Aortic root diameter (Not reported, 2.07 ± 0.12), and Ratio of left atrial diameter to aortic root diameter at end- diastole (Not reported, 1.19 ± 0.08) respectively.

These differences may relate to the difference in bodyweights, breeds and genetics variations of the sheep used in these studies.

Fractional shortening in the Egyptian sheep it was higher than reference value reported by Hallowell et al. [37] and lower than value reported by Roustaei et al. [2]. Fractional shortening showed lower values in studies made by many researchers [10, 38, 39] (38.4 ± 5.7% and 31.6 ± 1.8%, 32± 8 % respectively) than ours as animals were under sedation or general anesthesia.

Ejection fraction is higher in sheep compared to previous studies of Roustaei et al. and Hallowell et al. [2, 37]. This may be due to weight, species and genetic differences. Ejection fraction values in sheep is higher than those of the study were reported by Ikeda et al. [40] in 6 sheep (59.4 ± 4.9%), Ghanta et al. [41] in 5 sheep (51.4 ± 12.9%), and Locatelli et al. [10] in 7 sheep (53 ± 6.2%). Ikeda's and Ghanta's were using isoflurane anesthesia, while Ikeda et al. [40] were using diazepam to sedate the sheep but our study the sheep were completely awake this is may be the cause of our high result of ejection fraction.

Doppler echocardiography showed Mitral valve E_{max} values were lower than that of A_{max} with low E_{max} /A_{max} ratio in the sheep. This result is contrary to what reported by Leroux et al. [6] but agreed with Kirberger et al. [42] who reported lower E_{max} /A_{max} ratio in merino ewes.

Aortic valve V_{max} and pulmonary valve V_{max} values were (1.10 ± 0.17 and 1.04 ± 0.13) in sheep nearly similar to what has been recorded by Leroux et al. [6] (1.05 ± 0.14 and 0.99 ± 0.12) in Saanen goats respectively. In addition, Szaluś-Jordanow et al. [43] reported higher values of Aortic valve V_{max} and PG_{max} and Pulmonary valve V_{max} and PG_{max} in Polish Fawn Improved (PFI) and Polish White Improved (PWI) goats.

Conclusion

This study provides hemato-biochemical, and echocardiographic reference values for Egyptian Rahmany sheep in clinically healthy animals which can be used in clinical detection of cardiac diseases also, in human researches on cardiovascular abnormalities.

Conflict of interest
None.

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There is no financial issues to disclose in our study.

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سونار للقلب لتخطيط الابعاد القلبية الطبيعية و تحليل الدم و الكيماويات الدم الحيوية فى الاغنام الرحماني المصرية

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المعلومات المرجعية لتخطيط صدى القلب وأمراض الدم والكيمياء الحيوية لم يتم تسجيلها في الأغنام المصرية. الهدف من دراستنا هو تحديد النطاقات المرجعية لمعلمات تخطيط صدى القلب العادية باستخدام تقنيات M-mode و Doppler في الأغنام الرحماني المصرية جنبًا إلى جنب مع القيم المرجعية الكيميائية الحيوية للدم التي قيمت وظيفة القلب. في ٢٥ من الأغنام المصرية السليمة التي تتراوح أعمارهم بين ٤ و ٥ سنوات بوزن ٧٠-٨٠ كجم ، تم إجراء تخطيط صدى القلب لأغنام فى حالة اليقظة في وضع الاستلقاء الجانبي. تتضمن معلمات تخطيط صدى القلب في الوضع M أقطار نهاية البطين الأيسر ونهاية الانبساطي ، وسماكة الحاجز بين البطينين في الانبساط والانقباض ، وسماكة الجدار الخالي من البطين الأيسر في الانبساط والانقباض ، ومعدل ضربات القلب ، وحجم الانبساطي النهائي ، وحجم الانقباض النهائي ، والناتج القلبي وحجم الضربة وتقصير الكسر وكسر القذف. تم تسجيل قطر جذر الأبهر وقطر الأذين الأيسر ونسبة قطر الأذين الأيسر / الأبهر. تم استخدام تخطيط صدى القلب الدوبلري لتقييم سرعات تدفق الدم في الشريان الرئوي والشريان الأبهر: السرعة القصوى (PV) وتدرج الضغط (PG). تم الحصول على المعلمات الانبساطية للبطين الأيسر بما في ذلك السرعات المبكرة (Emax) والمتأخرة (Amax) ونسبة Emax / Amax. تشمل عينات الدم الكامل والمصل لأمراض الدم والكيمياء الحيوية ملف البروتينات وإجمالي البيليروبين والجلوكوز ووظائف الكلى وألانين أمينوترانسفيراز وأسبارتات أمينوترانسفيراز وغاما جلوتاميل ترانسفيراز وتروبونين القلب والبوتاسيوم والصوديوم والكلوريد والكالسيوم والمغنيسيوم والفوسفور. تم الإبلاغ عن اختلافات في الأغنام المصرية بالمقارنة مع سلالات الأغنام الأخرى.

في الختام ، يمكن تقييم معايير تخطيط صدى القلب ، والمعايير الكيميائية الحيوية للدم في الأغنام الرحماني المصرية ، وقدمت دراستنا نطاقات مرجعية طبيعية قد تكون مفيدة في التحديد الدقيق لهياكل ووظائف القلب الداخلية للمساعدة في تشخيص أمراض القلب.

الكلمات المفتاحية: الكيمياء الحيوية ,الدوبلر, الأغنام الرحماني المصرية، أمراض الدم ,تخطيط صدى القلب M-mode .