VALIDATION OF GESTATIONAL AGE BY DEVELOPING FORMULAE AND ASSESSING EMBRYONIC AND FETAL DEVELOPMENT BY ULTRASONIC FETOMETRY IN BANGLADESHI JAMUNAPARI CROSSBREED GOATS



Khadija Begum

Roll No.: 0121/01 Registration No.: 962 Session: Jan-June 2021

A thesis submitted in the partial fulfillment of the requirements for the degree of Master of Science in Theriogenology

> Department of Medicine and Surgery Faculty of Veterinary Medicine Chattogram Veterinary and Animal Sciences University Chattogram- 4225, Bangladesh

> > **SEPTEMBER, 2023**

Authorization

I hereby declare that I am the sole author of the thesis titled "Validation of gestational age by developing formulae and assessing embryonic and fetal development by ultrasonic fetometry in Bangladeshi jamunapari crossbreed goats". I also authorize the Chattogram Veterinary and Animal Sciences University (CVASU) to lend this thesis to other institutions or individuals for the purpose of scholarly research. I further authorize the CVASU to reproduce the thesis by photocopying or by other means, in total or in part, at the request of other institutions or individuals for the purpose of scholarly research.

I, the undersigned, and author of this work, declare that the electronic copy of this thesis provided to the CVASU Library, is an accurate copy of the print thesis submitted, within the limits of the technology available.

Khadija Begum September, 2023

VALIDATION OF GESTATIONAL AGE BY DEVELOPING FORMULAE AND ASSESSING EMBRYONIC AND FETAL DEVELOPMENT BY ULTRASONIC FETOMETRY IN BANGLADESHI JAMUNAPARI CROSSBREED GOATS

Khadija Begum

Roll No.: 0121/01 Registration No.: 962

Session: Jan-June 2021

This is to certify that we have examined the Master's thesis and have found that this is complete and satisfactory in all respects for evaluation by the examination committee and that all revisions proposed by the committee will be accomplished.

Supervisor Dr. Azizunnesa Professor Department of Medicine and Surgery Faculty of Veterinary Medicine Co-supervisor Dr. Md. Ahaduzzaman Associate Professor Department of Medicine and Surgery Faculty of Veterinary Medicine

Chairman of the Examination Committee Dr. Pankaj Chakraborty Professor and Head

Department of Medicine and Surgery Faculty of Veterinary Medicine Chattogram Veterinary and Animal Sciences University Chattoram-4225, Bangladesh

SEPTEMBER, 2023

Acknowledgement

I am eternally glad and indebted to Almighty Allah for providing me strength and sound health to successfully finish my research work successfully for the degree of Master of Science (M.S.) in Theriogenology.

First and foremost, I express my heartfelt respect, deepest sense of gratitude, sincere appreciation, and profound indebtedness to my supervisor, **Professor Dr. Azizunnesa** and co-supervisor **Dr. Md. Ahaduzzaman** for their invaluable advice, continuous support, and patience during my MS study. Their immense knowledge and plentiful experience have encouraged me in all the time of my academic and research period.

It is my privilege to acknowledge **Dr. Pankaj Chakraborty**, Professor and Head, Department and Medicine and Surgery, CVASU and **Prof. Dr. Bhajan Chandra Das**, Director, SAQTVH, CVASU for giving me the opportunity to do my research work at SAQTVH and their valuable advice and constant inspiration through the entire period of study. It is a good opportunity for me to pay special thanks to all the faculty members, the staffs, employee, laboratory technicians and the personnel of Department of Medicine and Surgery, Chattogram Veterinary and Animal Sciences University (CVASU). Their kind help and support have made my study fruitful.

I must not fail to sincerely appreciate and acknowledge the financial support from National Science and Technology, Ministry of Science and Technology, Bangladesh and Coordinator, Advance Studies and Research and Director, Research and Extension without which the research may not go smoothly.

Finally, an honorable mention goes to my families and friends for their blessing, inspiration, sacrifice, and spiritual support in completing my thesis.

Khadija Begum September, 2023

List of contents

Authorization	
Acknowledgement	iv
List of Contents	v-viii
List of Tables	ix
List of Figures	x-xi
List of Appendix	xii
List of Abbreviation	xiii
Abstract	xiv
Chapter 1: Introduction	1-3
Chapter 2: Review of literature	4
2.1. Pregnancy diagnosis of goat	4
2.2. Development of ultrasound scanning	5
2.3. Principle of ultrasound scanning	6-7
2.4. Factors and recommendations associated with the accuracy	
rate of ultrasound scanning	7-8
2.5. Application of Ultrasonography in Theriogenology	8-9
2.6. Gestational length in goat	9-10
2.7. Fetal biometry for assessing gestational age in goats	10-16
2.7.1. Gestational sac diameter (GSD) and Gestational sac	
length (GSL)	10-11
2.7.2. Placentome diameter (PD)	11-12
2.7.3. Crown-rump length (CRL)	12-14

2.7.4. Bi-parietal diameter (BPD)	14-15
2.7.5. Trunk diameter	16
Chapter 3: Materials and methods	17
3.1. Study area and period	17
3.2. Experimental animal	17
3.3. Materials	18
3.4. Preparation of animal	19
3.5. Ultrasonography of goat	19-21
3.6. Pregnancy diagnosis of goat	21-22
3.7. Ultrasonic assessment of fetal biometry in goat	22-26
3.7.1. Gestational sac length (GSL) and Gestational sac diameter	
(GSD)	24
3.7.2. Placentomes diameter (PD)	24-25
3.7.3. Crown-rump-length (CRL)	25
3.7.4. Biparietal diameter (BPD)	26
3.7.5. Trunk Diameter (TD)	26
3.8. Statistical analysis of data	27
Chapter 4: Results	28
4.1. Inventory of animals by ultrasound scanning	28
4.2. Estimation and comparative evaluation of gestational age by	
ultrasound scanning	29
4.3. Comparative evaluation of estimated and actual gestational	
age among three different gestational stage	30
4.4. Relationship of different parameters with actual gestational	
Age	31-39

4.4.1. Relationship between GSD and AGA	31-32
4.4.2. Relationship between GSL and AGA	32-33
4.4.3. Relationship between PD and AGA	33-34
4.4.4. Relationship between CRL and AGA	35-36
4.4.5. Relationship between BPD and AGA	36-37
4.4.6. Relationship between TD and AGA	37-38
4.5. Determination of expected days from delivery (EDD)	40-41
Chapter 5: Discussions	42
5.1. Pregnancy detection by Ultrasound scanning	42
5.2. Estimation of gestational age by measuring different	
parameters through Ultrasonography and comparison with	
actual gestational age in goat	42-43
5.3. Comparative evaluation of estimated and actual gestational	
age among three different gestational stage	43-44
5.4. Relationship of different measurable parameters with actual	
gestational age	44-47
5.4.1. Gestational sac (GSD and GSL)	44-45
5.4.2. Placentome diameter (PD)	45
5.4.3. Crown rump length (CRL)	46
5.4.4. Biparal diameter (BPD)	46-47
5.4.5. Trunk diameter (TD)	47
5.5. Expected days from delivery (EDD) in Bangladeshi crossbreed	
Goats	48

Chapter 7: Recommendations and future perspectives	
7.1. Recommendations	50
7.2. Future perspectives	50
References	51-60
Appendix	61-66
Biography	67

List of tables

Table 1: Number of animals measuring six different parameters at three different
gestation stages by ultrasound scanning23
Table 2: Assign the animals using ultrasonic scanning
Table 3: Estimation and comparison of gestational age by measuring
different parameters in goats
Table 4: Comparative study of gestational age between estimated and
actual gestational age in goats among three different gestational stages
using ultrasonography scanning30
Table 5: Gestational age prediction equation in Bangladeshi crossbreed
Goats
Table 6: Comparison of expected days from delivery (EDD) and actual
days from delivery (ADD) in goats40
Table 7: Comparative evaluation of estimated (EGA \pm 1-5 days) and
actual gestation age in goats41

List of figures

Figure 1:	Cross breed Jamunapari goat	17
Figure 2:	Ultrasound Machine (EXAGO, transabdominal probe (2.5-5.0 MHz) and coupling reagent (ultrasound gel)	10
Figure 3:	Preparation of goat for ultrasonography (shaving on lower abdomen)	18
Figure 4:	Transabdominal scanning of goat by ultrasound machine	20
Figure 5:	Ultrasound images of non-pregnant (a) and embryonic and fetal structures (b) (c) (d) at different gestational age	21-22
Figure 6:	Ultrasound image showing the measurement of GSD and GSL at different gestational age	24
Figure 7:	Ultrasound image showing the measurement of PD at different gestational age	25
Figure 8:	Ultrasound image showing the measurement of CRL at different gestational age	25
Figure 9:	Ultrasound image showing the measurement of BPD at different gestational age	26
Figure 10:	Ultrasound image showing the measurement of TD at different gestational age	26
Figure 11:	Linear regression curve representing the relationship between GSD and AGA	20
Figure 12:	Linear regression curve representing the relationship between GSD and AGA at early stage of gestation	32

х

Figure 13:	Linear regression curve representing the relationship between	
	GSL and AGA	32
Figure 14:	Linear regression curve representing the relationship between	
	GSL and AGA at early gestational stage	33
Figure 15:	Linear regression curve representing the relationship between	
	PD and AGA	34
Figure 16:	Linear regression curve representing the relationship between	
	PD and AGA at mid stage of gestation	34
Figure 17:	Linear regression curve representing the relationship between	
	CRL and AGA	35
Figure 18:	Linear regression curve representing the relationship between CRL and AGA at early stage of gestation	36
Figure 19:	Linear regression curve representing the relationship between	
	BPD and AGA	36
Figure 20:	Linear regression curve representing the relationship between	
	TD and AGA	37
Figure 21:	Linear regression curve representing the relationship between	
	TD and AGA at late stage of gestation	38

List of appendix

Questionnaire
Table 8: Estimation of gestational age by measuring GSD and comparison
with actual gestational age62
Table 9: Estimation of gestational age by measuring GSL and comparison
with actual gestational age63
Table 10: Estimation of gestational age by measuring PD and comparison
with actual gestational age64
Table 11: Estimation of gestational age by measuring CRL and comparison
with actual gestational age64-65
Table 12: Estimation of gestational age by measuring BPD and comparison
with actual gestational age
Table 13: Estimation of gestational age by measuring TD and comparison
with actual gestational age65
Table 14: Comparison of estimated gestational age with actual gestational
age66
Table 15: Regression equation that are used for estimation of gestational
age66

List of abbreviations

Abbreviation	Meaning
SAQTVH	Shahidul Alam Quaderi Teaching Veterinary Hospital
CVASU	Chattogram Veterinary and Animal Sciences University
GS	Gestational sac
GSD	Gestational sac diameter
GSL	Gestational sac length
PD	Placentome diameter
CRL	Crown rump length
BPD	Bi-parietal diameter
TD	Trunk diameter
GA	Gestational age
AGA	Actual gestational age
EGA	Estimated gestational age
ADD	Actual dates from delivery
EDD	Estimated dates from delivery
FAO	Food and agricultural organization
DLS	Department of livestock service
BCS	Body condition score
SD	Standard deviation

Abstract

The study was designed to estimate the gestational age and detect the appropriate parameter at different stage of gestation by measuring six different gestational parameters (CRL, BPD, TD, GSD, GSL and PD) through ultrasonography, assessing the relationship with actual gestational age in Bangladeshi Jamunapari cross breed goats. The study was conducted at SAQTVH, CVASU, Chattogram from Feb'21 to Jan'23. The does were examined trans-abdominally in standing position using 2.5-5MHz convex transducer by real time ultrasonography. Pregnancy was confirmed by amniotic fluid and fetal heartbeat in early stage and other fetal structures (skull, ribs, femur, placentomes, etc.) in mid and late stages of gestation. Parameters were measured for estimating gestational age while the actual gestational ages were collected from the history of delivery of doe. The values were analyzed statistically. The formulae were also generated from linear regression equation to calculate the gestational age in goats at different gestational stage. The estimated and actual GA were compared and differed significantly in all parameters except BPD and TD whereas PD showed non-significant variation (P>0.05) indicates as a reliable parameter for gestational age determination up to the 2nd trimester of pregnancy in studied population. The EGA and AGA was compared at three different stages (early, mid and late) of gestation where found a nonsignificant variation with a high coefficient of determination in case of GSD (R^2 = 0.92), GSL ($R^2 = 0.91$), and CRL ($R^2 = 0.92$) at early stage, PD ($R^2 = 0.80$) and BPD $(R^2 = 0.89)$ at mid stage and TD $(R^2 = 0.96)$ at late stage of gestation in estimating gestational age. The EGA \pm 1-5 (days) measurements were also calculated to estimate the expected days from delivery and showed no significant variance (P>0.05) with respect to all measured parameters in case of EGA+1-5 days but in case of subtracting 1-5 days, the analysis showed a significant variation with respect to all parameters except TD. From the present study, it could be concluded that the GSD, GSL and CRL is a highly reliable for the estimation of GA in 1st trimester where BPD, TD and PD are at 2nd trimester whereas during 3rd trimester TD is recommended. Expected days from delivery can also varied +1-5 days in case of the derived equation used for all six parameters but can vary ± 4 days in case of EDD based on TD measurements.

Keywords: Ultrasonography, Goat, Fetal parameters, Gestational age, EDD