

UNIVERSITI TEKNOLOGI MARA

**PHYSIOLOGICAL EFFECTS OF
PRENATAL ULTRASOUND
EXPOSURE ON
BONE-RELATED DEVELOPMENT
OF YOUNG RABBITS**

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Thesis submitted in fulfillment
of the requirements for the degree of
Doctor of Philosophy

Faculty of Health Sciences

June 2017

ABSTRACT

Prenatal ultrasound examination is routinely carried out on most pregnant women since it is considered to be safe. The procedure is however often exploited for social and business interest rather than for medical diagnosis. Despite this procedure having an excellent safety record, ultrasound imaging tends to evoke temperature increase due to heat absorption from prolonged ultrasound beams and leads to intrauterine hyperthermia. This ex-vivo experimental study was conducted to examine bone-related physiological changes of young rabbits exposed prenatally to ultrasound. *Oryctolagus cuniculus* were time-mated and assigned into control and experimental groups. The control group was allowed to have a full term delivery without any exposure to ultrasound. Each pregnant doe in the experimental group received a single exposure to ultrasound during the applicable gestational stage of the group to which it was assigned. The exposure lasted 30 min, 60 min, and 90 min at 1st, 2nd and 3rd stage, accordingly. For each exposure, the working frequency used was 5.76 MHz, and the mechanical (MI) and thermal indices (TI) recorded were 1.0 and 0.2, respectively. The calculated spatial peak-pulse average intensity (I_{SPPA}), spatial peak temporal average intensity (I_{SPTA}), and acoustic output power (P) were 1055 Wcm^{-2} , 7.21 mWcm^{-2} , and 20.20 mW, respectively. Once delivered, the offspring were used for data analysis. The 1 and 5 months subjects exposed prenatally to ultrasound at 2nd and 3rd stage for 90 min showed significant reduction ($p < 0.05$) in body length, femoral width and femoral length. Red blood cell and haemoglobin were found to reduced significantly ($p < 0.05$) in 1 month subjects at 1st and 2nd stage for all exposure duration, but no significant changes ($p < 0.05$) noted in 5 months subjects. The exposure has also significantly affected ($p < 0.05$) the parathyroid activity in 1 month subjects especially at 3rd stage for all exposure duration which cause a disturbance in the serum calcium level. The studied animal of 1 and 5 months age has shown poor bone status as described by significantly reduced ($p < 0.05$) in trabecular bone volume (BV/TV), trabecular thickness (Tb.Th) and trabecular number (Tb.N) after exposure at all gestational stages. Significant increased ($p < 0.05$) in porosity and tissue mineral density were found in both 1 and 5 months subjects after exposure at all gestational stages. Osteocytes loss were found higher ($p < 0.05$) in experimental groups of both 1 and 5 months subjects especially after 60 and 90 min of exposure in 2nd and 3rd stages as compared to control. The infrared microspectroscopic analysis demonstrated that the exposure increases tissue mineralisation without changing the stoichiometry of the bone as almost no significant changes ($p < 0.05$) noted in mineral-to-matrix ratio (M/M), mineral crystallinity (XST) and collagen maturity (XLR) in 5 months subjects. However, in 1 month subjects, significant reduction ($p < 0.05$) were found in diaphyseal M/M, XST and XLR after 90 min of exposure. The present study describing the detrimental effects following prenatal ultrasound exposure indicates that distinct skeletal alterations take place in young rabbits. The bony properties observed in the study showed significant impact on the bone quality. It is anticipated that this new knowledge may result in a precautionary measure in obstetric ultrasound scanning.

ACKNOWLEDGEMENT

In the name of Allah, the Most Gracious and Most Merciful. Alhamdulillah, all praise and glory to Almighty Allah for His blessings in completing this thesis. Peace and blessings of Allah be upon Prophet Muhammad (Peace Be upon Him).

I have taken efforts in this study, but it would not have been possible without the kind support and guidance of many individuals and organisation. Special appreciation goes to my supervisor, Prof Madya Dr Sulaiman Md Dom, for his supervision and constant support. His invaluable help of positive comments and suggestions throughout the experimental and thesis works have contributed to the success of this study. I also owe a debt of gratitude to my co-supervisor, Dr Hairil Rashmizal Abdul Razak for his support and guidance regarding my study.

I would like to express my appreciation to the members of the Faculty of Health Science (FSK) UiTM, in particular, the former Dean, Dr Hamzah Fansuri Hassan, the former Head of Post Graduate Centre, Dr Maria Justine @ Stephany, the former coordinator of Medical Lab Technology Department, Dr Mazura Bahari, who gave me full support in providing the requirements and facilities for my study, Medical Imaging Department staff especially Hj. Mohd Nadzri Mohd Yusoff for his guidance during my first year of this PhD study. Special thanks also go to the post graduate management staff, Pn. Nornaziha Jamil and Pn. Nurajulei Mat Jamin, for their consistent help towards my research affairs and last but not least, Mr. Mohd. Khairi Khalil for facilitating the H&E procedure.

Sincere thanks to the staff of Faculty of Veterinary Medicine, Universiti Putra Malaysia (UPM), especially the assistant science officer, Mr. Mohamed Halmi Othman (Department of Veterinary Pathology & Microbiology) and Mr. Yap Keng Chee (Department of Veterinary Clinical Studies) for their hard work and co-operation towards my data collection. My thanks also goes to Pn. Ubaidah Naim from Proofreaders United and Mrs. S. Saira Banu a/p K. Sekaran Nair for their effort in proofreading this thesis write up.

I also acknowledge my colleagues and friends especially Ummi Farhana, Ebby Anuar, Azrul Ismail, Farah Wahida, and others whom I had a pleasant and fruitful company.

No amount of words can adequately express the debt I owe to my family. Most importantly, my beloved husband, Said Mohd Shaffiq bin Said Rahmat for his unwavering love, encouragement, patience and sacrifice. Not forgetting my son, Said Muhammad Muqriuddin and daughter, Nur Adra Afeeya, who provided pleasant distraction and enjoyable moments during my study. Finally, I dedicate this thesis to my parents, Dato' Hj Che Isa bin Che Kob and Datin Hj Zahaleha bin Husain for their vision and determination to educate me, in-laws, brothers and sisters for their support and prayers. Alhamdulillah.

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