

Development of Obstetric Ultrasound & Prenatal Diagnosis in Singapore

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INTRODUCTION

In 1958 Ian Donald of Glasgow was the first to report on the diagnostic use of ultrasound. A year later, he applied ultrasound in obstetrics to visualize the fetus. Prof Stuart Campbell (formerly a research registrar under Professor Ian Donald at the Queen Mother's Hospital, later Professor of O&G, at Queen Charlotte's Maternity Hospital and then King's College Hospital Medical School London) pioneered the measurement of the fetal biparietal diameter using the Disonograph scanning apparatus in 1968. He published normograms for the biparietal diameter from the 13th weeks of gestation making cephalometry a standard tool for the assessment of fetal growth and maturity in 1971. He first reported the diagnosis by ultrasound of a 17 weeks anencephaly in 1972 & of spina bifida in 1975 and described the use of fetal femur length in second trimester dating in 1980. Prof Campbell was one of the pioneers that had taught and trained many Singapore O&G specialists in ultrasound and also lectured in Singapore a number of times.

SINGAPORE O&G ULTRASOUND BEGINNINGS

The development of obstetric ultrasound in Singapore followed closely the developments in UK. In 1972, Dr R Sivasamboo, head of O&G Department of Thomson Road General Hospital (TRGH) Department discussed with Prof SS Ratnam, head of university unit of KKH, regarding the possibility of getting equipment for ultrasound scanning in Singapore. Both were excited with the technology and the possible applications for our local patients. The ultrasound pioneers then were in Scotland and England, and there was also good work done in Germany. It was decided that for the first

machine, a Siemen's Vidoson 635 would be purchased as there was a local agent, and the cost was relatively low. Funds for purchase were obtained from the Singapore Turf Club. By late 1972, the machine arrived and was installed at Thomson Road General Hospital.

As Prof Ratnam was a co-project initiator, 2 doctors (Dr Tay Boon Lin and Dr Chew Shing Chai) from KKH were sent to TRGH for training which was provided by the vendor. One gynecologist from the Frauenklinik (Munich) provided hands on training for 2 weeks. By today's standards the machine was primitive. It was based on a pair of rotating transducers whose beams were reflected off a pair of parabolic mirrors through a water filled membrane. Thus it was a "real-time" device but the frequency was low and there was a 16.5 Hz flicker which was rather disturbing. The machine had to be rotated using its gantry which had 3 locks to allow for each plane to be interrogated. As it was usual to lock 2 planes and only use the third, it was often found that one needed more fingers than one possessed to hold down the necessary buttons. The German instructor brought with him a special tool which consisted of a wooden block with 2 protrusions and a strong rubber band to hold down the buttons thus leaving one's fingers free to move the gantry.

As the learning curve was very steep, Prof Stuart Campbell from London was invited to help and he duly arrived just before the Chinese New Year in 1973. But he had never used a Vidoson and so his only advice was to upgrade to the then "Rolls-Royce" of all machines namely a Nuclear Enterprise Disonograph although he provided encouragement and gave a few lectures.

The team persevered with the Vidoson, and began to run 2 sessions per week Wednesdays and Saturdays when patients were selected from KKH and sent by ambulance over to TRGH. By 1974, the ultrasound service was quite popular but it was restricted to the second trimester as it was not really possible to visualize below the pelvic brim. In gynaecology it was extremely useful to distinguish between a molar pregnancy and a viable one by about 12 weeks and it was very good for picking up placenta praevia which is an important cause of antepartum haemorrhage (APH). In those days, a large proportion of the antenatal beds were filled with APH patients and hypertensive disorders of pregnancy.

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The use of ultrasound allowed patients with upper segment placentas to be sent home but the Vidoson was not good enough to allow confident diagnosis of IUGR (intrauterine growth retardation). By late 1974, the consultants had begun to have faith in the diagnosis, so the number of patients went up to about 10 per session. Dr BL Tay went on a Colombo Plan fellowship from the Ministry of Health in 1975 to the Queen Mother's Hospital in Glasgow, Scotland. He was the first government doctor to be trained in obstetric ultrasound.

It was later felt that it was time to upgrade the machine and we must express thanks to the Committee at the Turf Club for allocating the quarter million dollars required to buy the machine (a colossal sum of money in 1976 when a Mercedes Benz cost 25 thousand). The huge machine (Nuclear Enterprise Disonograph NE 42000) was installed in the University Department of O&G, KKH in August 1976 (at the "Fertility Control Clinic" next to the operating area where terminations and culdoscopic sterilizations were performed). Dr SC Chew was a pioneer in the use of this machine. It was a separate room and it was there that proper scans especially measurements could be done as it had separate A-scan and B-scan modes. The machine was set at a system velocity of 1540 metres per second with the 2-5 MHz transducer and was without grey scale. The final upgrade to gray scale capability was made in 1977 and the manufacturers sent one doctor to their training course in the Department of Clinical Physics and BioEngineering in Glasgow in April 1978.

The limitations of that machine were that it was a static compound contact scanner requiring high operator skill and was thus operator dependent. The resolution was also limited. But it gave complete sweeps of the entire field and was excellent for multiple pregnancy and for maternal ascites. By today's standards, it was grossly inadequate for most clinical use and the popularity of obstetric ultrasound was very modest. There was only this one machine serving the whole of KK hospital, appointment was also difficult to come by. By 1979 the trend was towards smaller real time free-hand transducers and that trend has continued ever since. The only machine that we did not get in Singapore was the Australian made water-bath Octoson which gave splendid pictures but the patients had to be immersed.

The university ('U') unit in KKH acquired the ADR real-time gray scale machine soon after and through the recommendation of Prof Campbell, acquired the Hitachi EUB25, another real-time gray scale machine. Over the next few years, enthusiasm in obstetric ultrasound grew rapidly and the next machine that the government hospitals got was a Japanese made real time 'B' scanner in 1980. This was a Hitachi EUB40 acquired by the then Toa Payoh Hospital. Several obstetricians from both the university as well as government units were active in ultrasound scans but the idea of invasive procedures was frowned upon at that time, largely because of lack of familiarity and training. Soon after that, real-time ultrasound machines were widely available in the university unit and all government units in Singapore.

In 1982, Dr YC Wong went under the China Medical Board fellowship to understudy perinatal medicine and ultrasound in King's College Hospital, Denmark Hill, London; Yale University and UCLA Cedar Sinai Hospital. The concept of Antenatal Diagnostic Clinic (ADC) was conceived in 1984/85 in the then 'U' unit, KKH. A fetal maternal clinic with ultrasound scans and intervention was started in KKH which later was transplanted to NUH in 1985.

In 1984, Dr George SH Yeo went to UK on a Health Manpower Development Fellowship (HMDP) to understudy O&G ultrasound. He spent his gynaecology ultrasound attachment in the Middlesex Hospital Radiology Department under the tutorage of Ms Judy Adams and Dr William Lees, obstetrics ultrasound attachment in Glasgow with Ms Magarate McNay, courtesy of Prof Charles Whitfield and in London under the tutorage of Prof Stuart Campbell, Prof Charles Rodeck and Dr Kypros Nicolaides in King's College Hospital, Denmark Hill.

Dr George Yeo set up the ADC in SGH in 1987 and boosted up the services of the ADC in KKH in 1993. With Dr FM Lai, they established the current reference charts of foetal biometry in Asians of the Singapore population during 1989 to 1993. He wrote a software program in Clipper incorporating this data for service use in KKH till now. In 1994, SGH and not long after KKH were recognised by both the Royal College of Obstetricians and Gynaecologists and the Royal College of Radiologists for training in obstetric ultrasonography. They were the first two centres outside the United Kingdom to be awarded such recognition at the time.

The mid 1980s was the time obstetric ultrasound was hotly pursued by many O&G units and individual private obstetricians. There were many teaching programmes and workshops conducted yearly in the late 80s, culminating in much heightened awareness of prenatal diagnosis, mainly on fetal anomalies. The rapid development of ultrasound technology and services set the stage for routine prenatal diagnosis and for the national prevention of birth anomalies.

NATIONAL REGISTRIES

National interest on prenatal inherited Down syndrome and thalassaemia screening started in 1987 with a suggestion from the Ministry of Community Development to offer couples intending to get married to undergo a blood test (to screen for thalassaemia carriers). Major efforts were later initiated by MOH following a Cabinet meeting on 21 January 1989 which approved the recommendations of the Advisory Council on the Disabled to prevent disability. A series of meetings on the implementation of the recommendations of the Advisory Council were held. These stated the commitment to prevent Down syndrome, thalassaemia and perinatal asphyxia among the other initiatives that involved obstetrics.

By 1990, the MOH initiated the Enhanced Child Health Services targeting screening of beta thalassaemia, Down syndrome, developmental assessment, child

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psychiatric problems and congenital hypothyroidism. The National Birth Defect Registry (NBDR) and the National Thalassaemia Registry (NTR) were then initiated and sited in MOH on 1 January 1993 and SGH in 1992 respectively. Both these registries were initiated by the paediatricians and the MOH public health physicians. Both registries (NBDR 1 February 1999 & NTR 1 May 1997) later shifted to KK Women's and Children's Hospital. With the heightened interest in perinatal and birth defect epidemiology, Dr Tan Kok Hian from KKH went on a HMDP in Maternal Fetal Medicine in UK in 1994 focusing on perinatal audit and epidemiology.

ANTENATAL SCREENING OF THALASSAEMIA

Prof Wong Hock Boon is the pioneer in the treatment and screening of Thalassaemia in Singapore. Thalassaemia was then a disease little mentioned among the obstetricians despite being widely known among the paediatricians as the second commonest inherited genetic disease in Singapore. Screening of beta thalassaemia was established with the MCV below 80 fl (giving 99% sensitivity, 13% false positive and no false negative) through a research project sponsored by the then Science Council Research and Development Assistant Scheme BM/87/02. It was conducted as a joint effort between the O&G department of SGH with Dr George SH Yeo as the principal party and the Paediatrics department, NUH, with Prof HB Wong as the secondary party. A subsequent grant from the Totalisator Board STB/0012/1990 provided for validation of the findings.

The first prenatal diagnosis of beta thalassaemia carrier in Singapore was done by ultrasound directed fetal blood sampling by Dr George SH Yeo in SGH O&G department with globin chain biosynthesis in NUH paediatric laboratory in July 1987. The first prenatal diagnosis of a beta thalassaemia major without a previous index case in the family was done by the same team in September 1987. The SGH Department of O&G was also the first to implement thalassaemia screening in 1988-1989 following work done by Dr SH Yeo.

Prenatal Invasive Procedures

Amniocentesis for all pregnant women above 35 was recommended in the minutes of the MOH meetings to implement the recommendations of the Advisory Council on the Disabled in 1988. There was no serum screening at that time. Chorionic Villi Sampling (CVS) was introduced as a clinical service in SGH for alpha thalassaemia in 1987*. Amniocentesis became popular in the late 80s with CVS a much less frequent procedure in most centres. Fetal blood sampling became much more frequently done from the late 80s and many were done for karyotyping following late scans. Various experimental procedures were done in the mid and late 90s in various institutions. With no registry holding records of these procedures, little account was made of the other invasive procedures in Singapore.

The first Singaporean publication on ultrasound directed

procedures appeared in the March 1987 issue of the Medical Journal of Malaysia by Dr Charles MP Lim on CVS and quinacrine staining. At that time, amniocentesis for advanced maternal age was not even the accepted routine procedure in most of the O&G units. Karyotype studies were only available in the paediatrics laboratory pioneered by Professor Wong Hock Boon and Mr Chua Teck Sin.

Rhesus disease is exceedingly rare in Singapore. Although it was the 'bread and butter' condition for fetal in-utero blood transfusion in the west, the first in-utero transfusion here took place in KK Hospital in November 1993 resulting in a successful continuing pregnancy which was delivered 6 weeks later at 35 week gestation on 30 December 1993. (I am not aware of another case since then although other transfusions were done for various other indications).

SUBSPECIALTY DEVELOPMENT

Dr Yeoh Swee Choo went to Oxford for research on maternal cell traffic and the isolation & identification of fetal cells in the maternal circulation, obtaining a DPhil (Oxford) in 1991 adding to our knowledge on future directions of prenatal diagnosis. In 1990, subspecialty development was decided as the way to achieve medical excellence and KKH restructured its O&G units into 3 subspecialty departments with one dedicated to Maternal Fetal Medicine. In September 1993, KKH started the early pregnancy assessment unit (EPAU) concept for first trimester scans (with an ultrasound machine each in two assessment rooms - KKH B-Clinic Rooms B4 & B5) manned by staff and medical officers from MF Department. In the mean time besides KKH, SGH and NUH also rapidly developed advanced capabilities in prenatal diagnosis with many perinatologists and sonographers taking up overseas training. Dr Chang Tou Choong who had an MD on Measurement of Fetal Growth in London came to Singapore and contributed to the subspecialty development in SGH and later KKH. Dr Ann Tan, SGH went on HMDP to Yale Fetal Cardiac Center for training in fetal echocardiography under Dr J Copel in 1995.

ANTENATAL RISK ASSESSMENT

In the early 90s, MOH recommended offer of routine screening for all elderly pregnant mothers for Down syndrome in the fetus. Later the issue of serum screening for Down syndrome surfaced in Singapore. Due to the nature of the test, there was little awareness of the counselling and implementation of the test at that time. The triple serum test service was first started in the university by Dr Victor Goh and later at Thomson Medical Centre. Dr Lai Fon-Min from KKH went for HMDP in UK for Antenatal Risk Screening in 1996. He established norms and studied the effectiveness of serum screening for the Singapore population and later KK Hospital started the serum screening service. New tests like nuchal translucency for risks assessment are being evaluated.

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FIRST INTERNATIONAL SCIENTIFIC MEETING OF THE INTERNATIONAL SOCIETY OF ULTRASOUND IN O&G

A major milestone in obstetric ultrasound & prenatal diagnosis in Singapore will be the First International Scientific Meeting of the International Society of Ultrasound in O&G to be held on 21 to 24

March 2004 in Raffles City Convention Centre, Singapore. This would further boost the standard of obstetric ultrasound practice in Singapore and make Singapore a regional centre of obstetric ultrasound.

The above was compiled from interviews with Dr SC Chew, A/Prof BL Tay, A/Prof YC Wong and Dr Charles Lim.

**Date verified and amended from original article as 1987*

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A gathering of the organizing committee and teaching faculty of the First International Scientific Meeting of the International Society of Ultrasound in Obstetrics and Gynaecology (ISUOG), 22 March 2004 at Raffles City Convention Centre, Singapore



At the opening ceremony of the First International Scientific Meeting of the International Society of Ultrasound in Obstetrics and Gynaecology (ISUOG), 21 March 2004 at Raffles City Convention Centre, Singapore. From left: Prof Charles Ng, Dr Kelvin Tan, Dr Lee Keen Whye, A/Prof George SH Yeo, Dr S Balaji, Prof Karel Marsal, Dr TC Chang and Dr Sturla Eik-Nes.



Prof Stuart Campbell giving the 2004 OGSS Annual Oration, 23 March 2004



Prof Stuart Campbell with 2004 OGSS Members, 23 March 2004



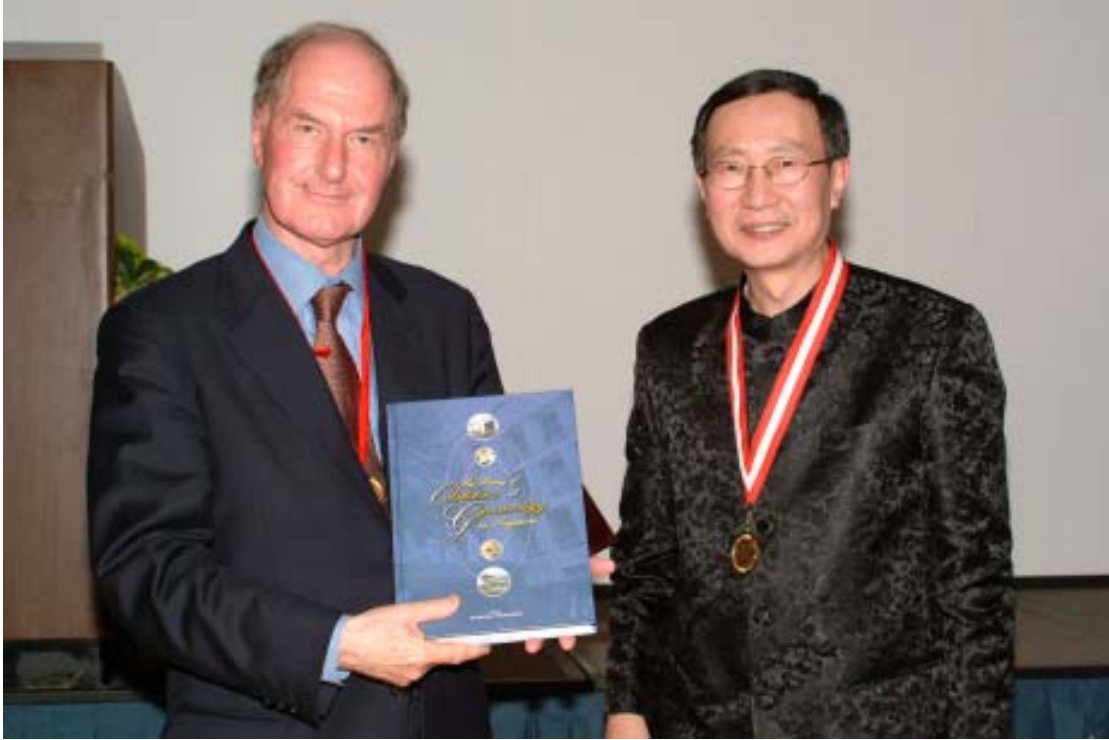
Prof Stuart Campbell with 2004 OGSS Members, 23 March 2004



Dr SC Chew, Ultrasound Pioneer in Singapore



A/Prof George SH Yeo, Chairman of the Organising Committee, First International Scientific Meeting of ISUOG



Prof Stuart Campbell (receiving the OGSS oration gold medal and OGSS History Book) with Dr Lee Keen Whye, President OGSS



Prof Stuart Campbell and Dr SC Chew, 23 March 2004 Sentosa