Professor Rashid Latif Khan Oration (8th SAFOG Conference: Colombo, 23rd April 2011)

Reproductive Health Research and Audit in Low Resource Settings

Malik Goonewardene

Vice President, SAFOG, Senior Professor and Head, Department of Obstetrics and Gynecology, University of Ruhuna, Sri Lanka

INTRODUCTION

"Because we are poor we can not afford not to do research"

Sri Jawaharlal Nehru, India

"If you are poor, actually you need more evidence before you invest, rather than if you are rich"

Hassan Mshinda, Tanzania

"In health care, invention and research is hard, but changing practice is even harder"

Berrick , UK

Research is needed to generate evidence as to which procedures or interventions are effective and which are not. Evidence for against a particular mode of diagnosis or management can change with time. The practice of evidence-based medicine (EBM) involves individualized management based on the integration of current best available evidence, individual clinical expertise and the available facilities and the patient's choice. Clinical expertise is essential to critically appraise and decide whether current best available evidence is appropriate to the individual patient at all, and if appropriate, how it should be applied.

Clinicians should have adequate knowledge of research methodology and be able to critically appraise research publications not only with regard to their scientific quality and validity but also their applicability to an individual patient. When considering applicability to individual patients, it would be necessary to consider the following: The presence of pathophysiological differences which could lead to different responses in different settings, issues of the intervention which could change the response, the presence of comorbidities which could alter the potential benefits or risks, and differences in base line risks which could affect the 'numbers needed to treat' and the 'numbers needed to harm'. Cultural issues, which will affect acceptability, cost effectiveness and feasibility especially in low resource settings, also need to be considered. The WHO Reproductive Health Library (RHL) contains RHL commentaries which are critical appraisals of Cochrane reviews. These RHL commentaries address these issues and are useful especially for practice in low resource settings. To practice EBM, a wealth of clinical expertise and, more importantly abundant commonsense is needed. Although EBM is considered to be a three ingredient recipe, the chef (clinician) needs to add salt and pepper and so on to taste.

Teaching Hospital Mahamodara Galle, Sri Lanka

The Teaching Hospital Mahamodara Galle (THMG), the only tertiary care gynecological and maternity hospital and referral center for the Southern Province of Sri Lanka and serving a population of approximately four million people, had very limited resources from its inception in 1980. It was badly damaged by the Tsunami on 26th December 2004 and had to be evacuated and abandoned. From mid February 2005, services recommenced in a couple of repaired wards. Although the patient care workload has returned to pretsunami levels, the floor space and bed strength continue to be approximately 50% of what it was before the tsunami and services are being continued in the midst of great difficulty to both patients and staff. Through the generosity of certain international organizations, a new fully equipped 600 bed maternity hospital was expected to be built and functional by 2009. However, construction of the new hospital has been delayed due to lack of funds and patient care services are being continued at THMG with great difficulty. In spite of these difficulties, reproductive health research and audit have continued uninterrupted in the academic unit of the THMG from its inception.

Research and Audit in the Academic Unit of the Teaching Hospital Mahamodara Galle

Several research projects have been carried out in the academic unit of the THMG during the last three decades. The areas of research included eclampsia and severe preeclampsia, gestational trophoblastic tumors, iron deficiency anemia, teenage pregnancy and sexual behavior of adolescents,

intraumbilical vein oxytocin for management of retained placenta, low tech antenatal and intrapartum fetal monitoring, preinduction cervical ripening, routine episiotomy, routine evacuation of retained products of conception after incomplete miscarriage, customized symphysio-fundal height charts and gestational age-specific birth weight centiles.

There are several ongoing clinical audits being carried out in the academic unit of the THMG currently. These include conscious outpatient hysteroscopy, urodynamic assessments and management of urogynecological problems, induction of labor, intraumbilical vein oxytocin for management of retained placenta, postpartum hemorrhage and cesarean sections.

Research and audit *per se* is not enough. It is necessary to 'get research into practice' as well as improve quality of care by the adoption of the audit cycle. Consequent to results and conclusions of the research studies and the clinical audits carried out, clinical practice has been changed and improved in the academic unit of the THMG during the last three decades. Out of the numerous areas where research has been carried out or is in progress at the moment, and the several ongoing clinical audits, a few have been selected for discussion.

IRON DEFICIENCY ANEMIA IN PREGNANCY

Hemoglobin Levels, Iron Deficiency Anemia and Iron Deficiency

Iron deficiency anemia (IDA) appeared to be high among the women presenting for antenatal care at the academic unit of the THMG. We carried out a cross-sectional cohort study on 236 consecutive women presenting for antenatal care during a two-month period in 1990. The rate of iron deficiency (ID) was 69% and it was significantly greater ($p < 0.05$) than the rate of IDA (56%) (Fig. 1). The Hb had a sensitivity of 63% and a negative predictive value of 41% in the detection of ID. The serum ferritin (SF) was positively correlated to the Hb, if the Hb was < 110 gm/l ($r^2 = 0.049$, $p < 0.001$), but it was not correlated if it was Hb ≥ 110 gm/l ($r^2 = 0.0003$, $p > 0.05$) (Table 1). Therefore, the Hb *per se* is not a good index for detecting ID[1].

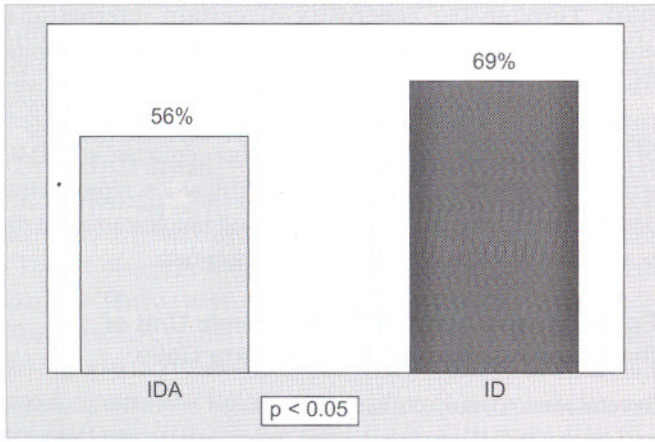


Fig. 1: Hemoglobin levels, iron deficiency anemia and iron deficiency (n = 236)[1]
IDA: Iron deficiency anemia (Hb < 110 gm/l)
ID: Iron deficiency (SF < 12 μg/l)

Table 1 Hemoglobin and serum ferritin[1]

Hemoglobin (gm/l) / Serum ferritin (μg/l)	*< 8*	*8-10.9*	*11-12.9*	*≥ 13*	*Total*
< 10	15	71	39	10	135
10-11.9	2	14	8	3	27
12-59.9	1	28	27	10	66
≥ 60	0	2	5	1	8
Total	18	115	79	24	236

Antenatal Routine Oral Iron Supplementation

We carried out a prospective cohort study on 88 consecutive pregnant women presenting for antenatal care with periods of gestation between 14 and 24 weeks, during a six-week period in 1992. The effectiveness of the ongoing antenatal routine oral iron supplementation program was suboptimal. A significant increase of Hb and SF ($p < 0.001$) was seen only in the women who had Hb <100 gm/l and SF < 10 μg/l. Many pregnant women were taking their iron and calcium supplements together, after a dinner of rice and vegetables, sometimes with tea, and only 58% of women had taken the supplements regularly. The bran in the red rice commonly consumed in Sri Lanka; phytates and polyphenolic compounds in vegetables, calcium and tea are all inhibitors of oral iron absorption. Therefore, the compliance and the manner in which the supplements are taken need improvements in order to achieve better results.[2]

Correlation of Maternal Iron Status with Iron Status of the Newborn

We carried out a cross-sectional cohort study in 74 pregnant women in stage II of labor. The iron stores of the neonate were positively correlated with the iron stores of its mother, while no similar correlation was seen with Hb (Tables 2 and 3).[3] Low iron stores in the neonate are known to lead to anemia during infancy, poor physical and mental growth and cognitive

Table 2 Maternal and cord serum ferritin (SF) μg/ml[3]

Maternal SF / Cord SF	*< 12*	*12-59.9*	*≥60*	*Total*
< 12	2	1	–	3
12-19.9	4	1	–	5
20-59.9	8	5	–	13
≥ 60	8	41	4	53
Total	22	48	4	74

($r^2 = 0.31$, 95% CI = –0.09 to 0.51; $p < 0.01$)

Table 3 Maternal and cord hemoglobin concentrations (Hb) gm/l[3]

Maternal Hb / Cord Hb	*< 8*	*8-10.9*	*11-12.9*	*≥ 13*	*Total*
< 10	–	2	1	–	3
10-12.4	4	10	4	5	23
12.5-14.9	1	3	13	3	20
≥ 15	1	8	9	10	28
Total	6	23	27	18	74

($r^2 = 0.26$, 95% CI = 0.03 to 0.46; $p > 0.05$–not significant)

functions leading to poor learning abilities continuing throughout childhood and adolescence and even permanent neurophysiological deficiencies.[4-6] Therefore, it is important to ensure that pregnant women have adequate iron stores prior to delivery.

The Validity of Hematological Indices in Diagnosing Iron Deficiency

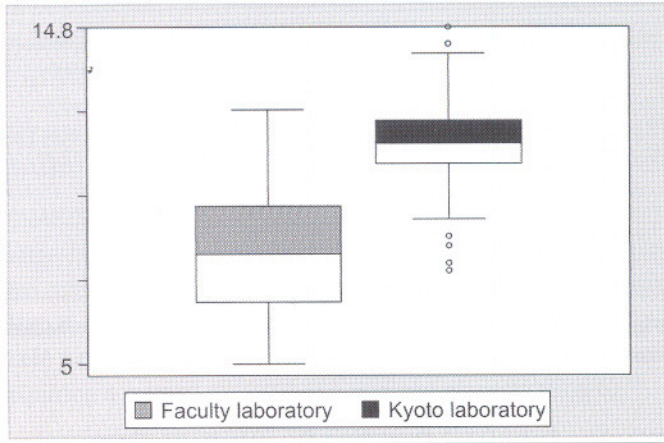
We carried out a cross-sectional study on two cohorts of women: In the second trimester (n = 156) and in the third trimester (n= 47). In the second trimester, the sensitivity (92%) and negative predictive value (80%) of the mean corpuscular hemoglobin (MCH) were markedly greater ($p < 0.001$) than the corresponding indices for Hb in detecting ID. However, the MCH had very low specificity (21%). The specificity of the hematocrit (97%) was markedly better than that of Hb (77%) (Table 4).[7]

In the third trimester, the mean corpuscular hemoglobin concentration (MCHC) had the best accuracy (71%) with 100% specificity and positive predictive values. However, in the third trimester, the MCHC had very low sensitivity (38%) (Table 5).[7] Therefore, because a single hematological index *per se* has a poor ability of detecting or excluding ID in pregnancy, several indices should be evaluated prior to antenatal iron supplementation or iron therapy.[7]

Agreement between Hemoglobin and Hematocrit Levels obtained from Different Laboratories

Subsamples of the same samples of blood obtained from the previous study were sent to different laboratories for estimation. We found that the Hb values obtained from three different laboratories, which used different methods of assessment, differed significantly in the second trimester ($p < 0.007$) as well as in the third trimester ($p < 0.02$) (Figs 2 and 3).

The mean hematocrit values obtained from two laboratories in the third trimester were not significantly different from each other. Although there was poor agreement between the hematocrit values obtained from two laboratories and the mean hematocrit showed a difference of 0.4% in the second trimester, these differences in mean hematocrit were not clinically significant. A single Hb measurement should be interpreted with caution. The use of hematocrit in addition to the Hb may increase the diagnostic accuracy.[8]



Hemoglobin levels	*Mean*	*Standard deviation*	*95% confidence interval*
Faculty laboratory	8.3	1.7	8.0-8.5
Kyoto laboratory	11.4	1.2	11.2-11.6
	$p < 0.001$		

Fig. 2: Hemoglobin concentration estimations in second trimester: faculty laboratory *vs* Kyoto laboratory (n = 156)[7]

Table 4 The validity of hematological indices in diagnosing iron deficiency during the second trimester (n = 156)[7]

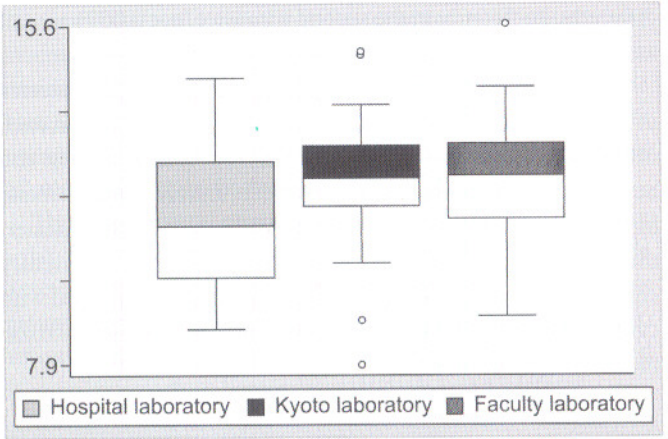
Hematological index	*Sensitivity*	*Specificity*	*Positive predictive value*	*Negative predictive value*	*Accuracy*
Hb < 110 gm/l	0.48	0.77	0.58	0.69	0.65
Hct < 33%	0.18	0.97	0.79	0.63	0.65
MCV < 80 fl	0.10	0.98	0.75	0.62	0.62
MCH < 30 pg/l	0.92	0.21	0.44	0.80	0.50
MCHC < 30%	0.14	0.97	0.75	0.62	0.64
RBCC < 4.1 million/mm^3	0.63	0.47	0.44	0.66	0.53

Hb: Hemoglobin concentration; Hct: Hematocrit; MCV: Mean corpuscular volume; MCH: Mean corpuscular hemoglobin; MCHC: Mean corpuscular hemoglobin concentration; RBCC: Red blood cell count

Table 5 The validity of hematological indices in diagnosing Iron deficiency in the third trimester (n = 47)[7]

Hematological index	*Sensitivity*	*Specificity*	*Positive predictive value*	*Negative predictive value*	*Accuracy*
Hb < 110 gm/l	0.38	0.92	0.80	0.64	0.67
Hct < 33%	0.10	0.96	0.67	0.56	0.57
MCV < 80 fl	0.19	0.96	0.80	0.58	0.61
MCH < 30 pg/l	0.86	0.24	0.49	0.67	0.52
MCHC < 30%	0.38	1.0	1.0	0.66	0.71
RBCC < 4.1 million/mm^3	0.17	0.68	0.33	0.46	0.43

Hb: Hemoglobin concentration; Hct: Hematocrit; MCV: Mean corpuscular volume; MCH: Mean corpuscular hemoglobin; MCHC: Mean corpuscular hemoglobin concentration; RBCC: Red blood cell count



Hemoglobin levels	*Mean*	*Standard deviation*	*95% confidence interval*
Hospital laboratory	11.1	1.4	10.7-11.5
Kyoto laboratory	12.0	1.4	11.6-12.4
Faculty laboratory	12.0	1.4	11.5-12.4
	Kappa		
Faculty/Kyoto	0.62		
Kyoto/Hospital	0.28		
Faculty/Hospital	0.28		

Fig. 3: Hemoglobin concentration (Hb) estimations in third trimester: hospital laboratory *vs* kyoto laboratory *vs* faculty laboratory (n = 47)[7]

Weekly Antenatal Oral Iron Supplementation

It has been suggested that daily oral iron supplementation results in high iron levels in the intestinal lumen and intestinal mucosal cells, resulting in an increased severity and frequency of undesirable gastrointestinal side effects, and progressively reduced further iron absorption. Therefore weekly supplements, based on a mucosal cell turnover of 5 to 6 days, which may improve iron absorption and patient compliance, have been suggested as a better option as it is equally effective as daily supplements.[9,10] We conducted two preliminary studies on weekly[11] and thrice weekly[12] antenatal oral iron supplementation. There were no significant side effects when the iron supplement was given weekly and women complied with this regimen. However, weekly supplements were inadequate to meet the increased iron requirements of pregnancy especially in women with borderline or mild ID.[11] Supplements given three times a week apparently met the additional requirements of pregnancy and improved the iron status in IDA and ID. There were no side effects and the compliance was good.[12] However, these preliminary studies suggested that all pregnant women would benefit from daily oral iron supplementation, and intermittent oral iron supplementation was inappropriate in South Asian countries where women were at risk of IDA (Table 6).[13,14]

A radioisotopic iron absorption study had found no evidence of any progressive mucosal block following daily oral iron. This study also showed that iron supplements given twice weekly with food provided < 10% of the iron requirements during the third trimester of pregnancy (Table 7).[15] We carried out a randomized controlled trial to determine the effectiveness of antenatal oral iron supplements given daily (n = 26), thrice weekly (n = 35) and weekly (n = 31). Only daily oral iron supplementation was effective in preventing ID and IDA at term. Thrice weekly supplements carried a greater risk of developing ID at term (Odds ratio 10.1, 95% CI 1.6-64.8, p < 0.002) and weekly supplements carried a very high risk of developing ID (Odds ratio 18.1, 95% CI 2.8-115.5, p < 0.002) and IDA (Odds ratio 15, 95% CI 14-165.6, p < 0.03) (Tables 9 and 10).[16] Studies carried out in Pakistan[17] and Iran[18] too have shown that intermittent oral iron supplementation is not effective in preventing ID and IDA at term, and therefore, it is inappropriate in communities with a high prevalence if ID and IDA.[16-19]

Table 6 Risk of developing iron deficiency anemia (Hb < 110/l)[16]

Antenatal oral iron supplementation	*Odds ratio*	*95% CI*	*p*
Once a week (n = 26)	15	14-165.6	< 0.03
Thrice a week (n = 35)	3.1	0.3-30.3	Not significant
Daily (n = 31)	0.9	0.5-17.7	Not significant

Table 7 Risk of developing iron deficiency (SF < 12 μg/l)[16]

Antenatal oral iron supplementation	*Odds ratio*	*95% CI*	*p*
Once a week (n = 26)	18.1	2.8-115.5	< 0.005
Thrice a week (n = 35)	10.1	1.6-64.8	< 0.02
Daily (n = 31)	1	0.1-9.5	Not significant

Anemia and Its Prevention

It has been estimated that globally more than 56 million pregnant women are anemic and of whom more than 32 million are from Asia (Fig. 4). The estimated prevalence of anemia in pregnant and nonpregnant women in South Asia is presented in Figure 5.[20] In order to prevent ID and IDA of pregnancy, certain programs have been proposed (Table 8).

Table 8 Possible oral iron and folic acid supplementation programs to prevent anemia in pregnancy

Target group	*Program*	*Duration*
All pregnant women including adolescents in communities where IDA is considered a problem	Daily iron 60 mg + folic acid 0.4 mg	Throughout pregnancy starting as early as possible
All pregnant women including adolescents in communities where IDA is not considered a problem	Daily iron 30 mg + folic acid 0.4 mg	Throughout pregnancy starting as early as possible
Postpartum women including adolescents	Continue antenatal supplementation	6 months
All menstruating women including adolescents	Weekly iron 60 mg + folic acid 2.8 mg	Three months and repeated at six monthly intervals

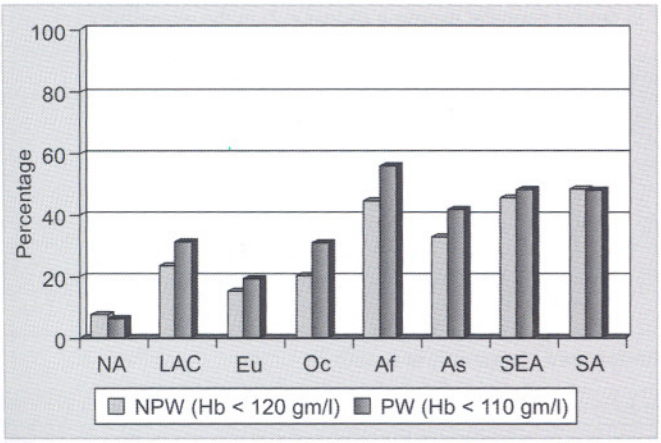


Fig. 4: WHO Global Database of Anemia (1993-2005) (nonpregnant women and pregnant women)[20]
Hb: Hemoglobin level; NPW: Nonpregnant women = 468 million (318 m in Asia); PW: Pregnant women = 56 million (32 m in Asia); NA: North America, LAC: Latin America + Caribbean, Eu: Europe, Oc: Oceania; Af: Africa, As: Asia, SEA: South East Asia, SA: South Asia

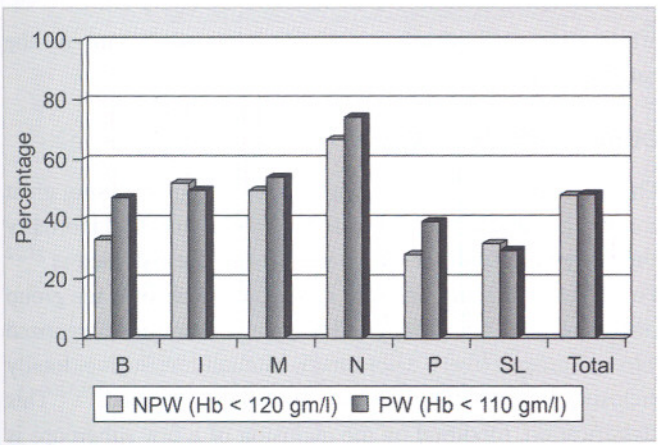


Fig. 5: WHO Global Database of anemia in South Asia (1993-2005) (nonpregnant women and pregnant women)[20]
Hb: Hemoglobin level; NPW: Nonpregnant Women, PW: Pregnant women; B: Bangladesh; I: India; M: Maldives; N: Nepal; P: Pakistan; SL: Sri Lanka

Teenage Pregnancy and Sexual Behavior of Adolescents

In 2001, approximately 5.6 million (28%) of the population in Sri Lanka consisted of adolescents and young adults. By 2007, approximately 4.9 million (26%) of the population were below 15 years of age.[21,22] During the last three decades, although the contraceptive prevalence rate of Sri Lanka has progressively increased to 68% and the total fertility rate has decreased to 2.3%, the age-specific fertility rate for teenagers between 15 and 19 years has shown only a mild decrease from 38/1000 in 1987 to 28/1000 in 2007.[21,22] Teenage pregnancies were causing concern and we found that the contraceptive usage among teenagers was low and this was mainly due to lack of knowledge and fear of side effects resulting in up to 62% in pregnancies being unplanned and these could have been prevented by providing contraceptive counselling and services.[23,24] We also found that teenage pregnancies especially less than 17 years were significantly associated with poverty, poor education, anemia, pregnancy-induced hypertension and preterm deliveries.[24] We also found that up to 16% of male and 8% of female adolescent school children in the southern province of Sri Lanka were sexually active and there was an increased prevalence of sexual activity in those from upper socioeconomic strata and those living apart from their parents.[25] Although student counsellors were available in more than 50% of the schools, only 11% of female and 19% of male students obtained counselling in schools. In seeking sexual advice, the mother was the first choice in 64% of females but only in 18% of males. More male students sought sexual advice from peers (24%) and doctors (20%) compared with females (6 and 7%, respectively).[25]

INTRAUMBILICAL VEIN OXYTOCIN FOR MANAGEMENT OF RETAINED PLACENTA

The technique of injecting 50 IU of oxytocin in 30 ml of normal saline into the umbilical vein is a feasible and effective first-line management option in women having retained placenta. With the adoption of this technique in our department in 2008, there has been a dramatic reduction in the number of women requiring a manual removal of a retained placenta (Fig. 6).[26]

THE FETAL ACOUSTIC STIMULATION TEST FOR ANTENATAL AND EARLY INTRAPARTUM FETAL MONITORING

Fetal acoustic stimulation results in fetal movements and acceleration of the fetal heart rate, if the fetus is not hypoxic. We carried out the fetal acoustic stimulation test (FAST) in 423 high-risk pregnant women at > 32 weeks gestation, of whom 371 had possible antepartum hypoxia.[27] The FAST can be applied if the nonstress test (NST) is nonreactive after 10 mins and, therefore, shortens the time needed for a NST. It significantly reduces false positive (nonreactive) NST (Table 9). We also carried out the FAST in 486 women with uncomplicated singleton pregnancies in spontaneous labor at > 32 weeks gestation.[28] In detecting fetal hypoxia, the FAST was found to have a better specificity and positive predictive value compared with NST in the antepartum and early intrapartum periods. The FAST is a cost-effective and reliable preliminary screening procedure for antepartum and early intrapartum fetal monitoring and it complements the NST[27,28] (Tables 10 and 11).

Table 9 Antepartum FAST results and NST results before and after FAST in the women with possible hypoxia (n = 371)[27]

	NST before FAST		*NST after FAST*		
	Non-reactive	*Reactive*	*Total*	*Non-reactive*	*Reactive*
FAST no movements	40	33	40	33	73
FAST movements +	50	248	07	291	298
Total	90	281	47	324	371

Table 10 Ability of antepartum FAST and NST before and after FAST to predict neonatal asphyxia (Apgar < 7) in the women who delivered within 24 hours (n = 97)[27]

	FAST (%)	*NST before FAST (%)*	*p*	*NST after FAST (%)*	*p*
Sensitivity	93	100	< 0.01	100	–
Specificity	79	45	< 0.001	75	< 0.001
Negative predictive value	96	100	< 0.05	100	–
Positive predictive value	67	50	< 0.02	64	< 0.05
Accuracy	83	69	< 0.03	82	< 0.04
Likelihood ratio of a positive test	4.4	1.8	–	4	–
Likelihood ratio of a negative test	0.9	0	–	0	–

Table 11 Ability of early intrapartum FAST and NST to predict neonatal asphyxia (Apgar < 7) (n = 486)[28]

	FAST (%)	*NST before FAST (%)*	*p*	*NST after FAST (%)*	*p*
Sensitivity	85	100	< 0.001	100	–
Specificity	91.	62	< 0.001	99	< 0.001
Positive predictive value	45	19	< 0.001	74	< 0.001
Negative predictive value	99	100	Not significant	100	–
Accuracy	91	65	< 0.001	97	< 0.001
Likelihood ratio of a positive test	9.4	2.6	–	100	–
Likelihood ratio of a negative test	0.2	0	–	0	–

THE NITRIC OXIDE DONOR ISOSORBIDE MONONITRATE VAGINALLY FOR PREINDUCTION CERVICAL RIPENING

Vaginal prostaglandin E_2 is not freely available and is in short supply in Galle, Sri Lanka. Nitric oxide (NO) has been shown to be a primary mediator in cervical ripening,[29] and the effectiveness of NO donors for preinduction cervical ripening is currently being evaluated.[30] We carried out a double blind placebo controlled randomized trial on 156 women with uncomplicated singleton pregnancies and modified Bishop Scores (MBS) < 5 at 41 weeks gestation. Vaginal administration of 60 mg isosorbide mononitrate (ISMN) in a sustained release form (ISMN-SR) was effective as a preinduction cervical ripening agent and did not result in any significant side effects other than a mild headache which responded to mild analgesics.[31] We carried out another similar trial on 156 women with uncomplicated singleton pregnancies and modified Bishop Scores (MBS) < 5 at 40 weeks + 5 days to 41 weeks gestation and compared the effects of ISMN 40 mg and ISMN-SR 60 mg versus placebo. Vaginal ISMN 40 mg and ISMN-SR 60 mg led to significantly greater cervical ripening after 6 and 48 hrs, respectively, compared with the placebo. As the effect was greater, ISMN-SR is preferable for preinduction cervical ripening.

Doppler velocimetry studies showed no significant changes in the umbilical artery, pulsatality and resistance indexes. An increase of maternal pulse rate and a decrease of systolic blood pressure were observed. Both changes were clinically nonsignificant. The main side effect was a mild headache which responded to mild oral analgesics. Another double-blind randomized control trial is currently in progress in our department to evaluate the effectiveness of vaginal ISMN-SR 60 mg administered on two consecutive days versus three consecutive days and also to study the feasibility and effectiveness of outpatient self-administered therapy by the patient herself.

CESAREAN SECTIONS

The global increase of cesarean sections (CS) is causing great concern because of the associated increased maternal mortality and severe morbidity, even after adjusting for risk factors.[31,32] To address this issue, an audit is required. Robson's ten group classification, of CS, in which all pregnant women are categorized into ten prospectively determined, mutually exclusive, totally inclusive and clinically relevant groups can be used.[33,34] This classification, modified by the inclusion of a few subgroups is being used in our department from 2010. Using this classification, it is possible to study the pattern of CS in a particular unit during a specific period of time and compare the data prospectively as well as carry out comparisons with data from another unit which has adopted this classification. Audits and comparisons at local, regional, national and even international level are possible (Table 12). When the pattern of CS in a particular unit is recognized, a detailed analysis of CS, including the indications for CS, is required to decide whether the CS rate needs to be reduced and, if so, how it could be reduced. A subsequent reaudit using the same categories would demonstrate reducing trends if any, after the adoption of appropriate changes in clinical practice and also identify areas which require further improvements. Important differences between units have been observed in those groups which contribute to almost half of the total CS *viz* 5A and 5B (repeat CS), 2B (nulliparous term singleton vertex NTSV, prior to onset of labor), 2A (NTSV after induction of labour) and 1 (NTSV in spontaneous labor). Detailed analyses of indications for CS in these groups have revealed possible areas where clinical practice can be changed and CS rates safely reduced without increasing the risk of adverse outcomes for the mother or her baby.

Table 12 Ten categories of pregnant women

1. Nulliparous women with a single cephalic pregnancy, at greater than or equal to 37 weeks gestation, in spontaneous labor.
2. A. Nulliparous women with a single cephalic pregnancy, at greater than or equal to 37 weeks gestation, who have induction of labor.
   B. Nulliparous women with a single cephalic pregnancy, at greater than or equal to 37 weeks gestation, who are delivered by cesarean section prior to the onset of labor.
3. Multiparous women, without a previous uterine scar, with a single cephalic pregnancy at greater than or equal to 37 weeks gestation, in spontaneous labor.
4. A. Multiparous women, without a previous uterine scar, with a single cephalic pregnancy at greater than or equal to 37 weeks gestation, who have induction of labor.
   B. Multiparous women, without a previous uterine scar, with a single cephalic pregnancy at greater than or equal to 37 weeks gestation, who are delivered by cesarean section prior to the onset of labor.
5. A. Multiparous women, with one previous uterine scar and a single cephalic pregnancy at greater than or equal to 37 weeks gestation.
   B. Multiparous women, with more than one previous uterine scar and a single cephalic pregnancy at greater than or equal to 37 weeks gestation.
6. Nulliparous women with single breech pregnancy.
7. A. Multiparous women with a single breech pregnancy, without previous uterine scar/s
   B. Multiparous women with a single breech pregnancy, with previous uterine scar/s
8. A. Women with multiple pregnancies, without previous uterine scar/s
   B. Women with multiple pregnancies, with previous uterine scar/s
9. A. Women with a single pregnancy with a transverse or oblique lie, without previous uterine scar/s
   B. Women with a single pregnancy with a transverse or oblique lie, with a previous uterine scar/s
10. A. Women with a single cephalic pregnancy at less than or equal to 36 weeks gestation, without previous uterine scar/s
    B. Women with a single cephalic pregnancy at less than or equal to 36 weeks gestation, with previous uterine scar/s

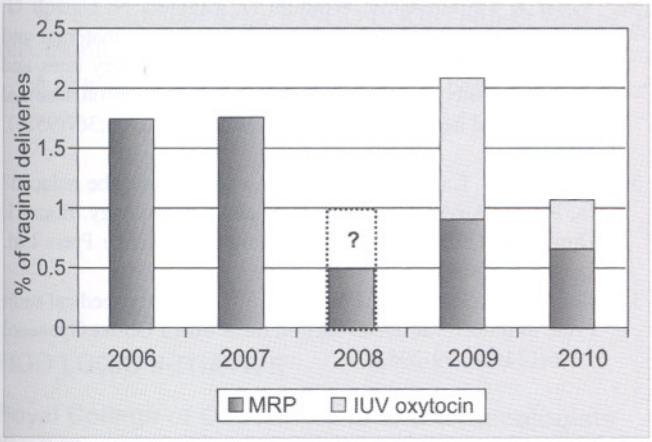


Fig. 6: Retained placenta successfully managed with intraumbilical vein oxytocin[26]

MRP: Manual removal of placenta; IUV oxytocin: Intraumbilical vein oxytocin; ?: Unrecorded % of IUV oxytocin usage (only MRP recorded)

CONCLUSION

Research is essential in nations with limited resources, in order to generate evidence to invest in cost-effective, feasible interventions, without wasting the limited resources available on interventions which are expensive and not cost-effective. Clinicians need to be able to critically appraise research publications for scientific quality and validity as well as applicability to individual patients, cost-effectiveness and feasibility, for which clinical experience and common sense are essential. The Teaching Hospital Mahamodara Galle (THMG) in Sri Lanka, had very limited resources from its inception in 1980. After the December 2004 tsunami, conditions became worse. Reproductive health research and audit, however, have continued uninterrupted from its inception. Consequent to the results and conclusions of these research studies and audits, clinical practice has been changed and improved in the academic unit of the THMG.

REFERENCES

1. Goonewardene M, Seekkuge J, Liyanage C. Iron stores and its correlation to haemoglobin levels in pregnant women attending an antenatal clinic. Ceylon Med J 1995;40:67-69.
2. Goonewardene IMR, Liyanage C. Efficacy of the current antenatal oral iron supplementation programme. Sri Lanka J Obstet Gynaecol 1996;18:14-17.
3. Goonewardene IMR, Liyanage C. Iron status of parturient mothers and in their new born babies. Ceylon Med Sci 1996; 39(1):35-39.
4. Singla PN, Tyagi M, Shankar R, et al. Fetal iron status in maternal anaemia. Acta Paediatr 1996;85:1327-30.
5. Lozoff B, Beard J, Connor J, et al. Long-lasting neural and behavioral effects of iron deficiency in infancy. Nutr Rev 2006; 64(5 Pt 2):S34-43.
6. Lukowski AF, Koss M, Burden MJ, et al. Iron deficiency in infancy and neurocognitive functioning at 19 years: Evidence of long-term deficits in executive function and recognition memory. Nutr Neurosci 2010;13(2):54-70.
7. Goonewardene IMR, Fernando RJ, Liyanage C, Somasiri KG. The validity of commonly used haematological indices in the detection of iron deficiency in pregnancy. Ceylon Med Sci 2001; 44(iv):29-34.
8. Goonewardene IMR, Fernando RJ, Liyanage C, Somasiri KG. The agreement between haematological indices obtained by different methods. Galle Med J 2000;2(1):13-17.
9. Viteri F. Weekly compared with daily iron supplementation. Letter to the Editor. Am J Clin Nutr 1996;63:610-14.
10. Pena-Rosas JP, Viteri FE. Effects and safety of preventive oral iron or iron + folic acid supplementation for women during pregnancy. Cochrane Data Base of Systematic Reviews 2009, Issue 4. Art. No: CD004736. DOI: 10.1002/14651858. CD004736 pub.
11. Goonewardene IMR, Liyanage C. Antenatal iron supplementation; once a week only. Sri Lanka J Obstet Gynaecol 1996; 18:18-21.
12. Goonewardene IMR, Liyanage C. Antenatal iron supplementation; only thrice a week. Ceylon J Med Sci 1996; 39(1):41-47.
13. Goonewardene M. Do all pregnant women need iron? Sri Lanka J Obstet Gynaecol 1999;21:2-5.

14. Goonewardene M. Is intermittent oral iron supplementation in pregnancy appropriate for South Asian Countries? Obstetrics and Gynaecology Communications 2000;2(4):14-16.
15. Cook JD, Reddy MB. Efficacy of weekly versus daily iron supplementation. Am J Clin Nutr 1995;62:117-120.
16. Goonewardene M, Liyanage C, Fernando RJ. Intermittent oral iron supplementation during pregnancy. Ceylon Med J 2001; 46(iv):132-35.
17. Mumtas Z, Shahab S, Butt N, et al. Daily iron supplementation in pregnant women in Pakistan in a randomised double blind clinical trial. Nutr 2000; 130 (11):2697-702.
18. Zamani AR, Farajadegan Z, Ghahiri AA, et al. Effectiveness of twice weekly iron supplementation compared with daily regimen in reducing anaemia and iron deficiency during pregnancy: A Randomised Trial in Iran. J Res Med Sc 2008;13(5):230-39.
19. Hallberg L. Combating iron deficiency: Daily administration of iron is far superior to weekly administration. Am J Clin Nutr 1998;68:213-17.
20. World Health Organization. Worldwide prevalence of anaemia 1993-2005. WHO Global Database on Anaemia. de Benoist B, Mclean E, Egli I, Cogswell M (Eds). World Health Organization, Geneva 2008.
21. Sri Lanka Demographic and Health Survey 2006/7. Department of Census and Statistics in Collaboration with Ministry of Healthcare & Nutrition (http://www.statistics.gov.lk/DHS/DHS%20Sri%20Lanka%20Preliminary%20Report.pdf) accessed 28th March 2011.
22. Annual Report on Family Health 2006-2007, Family Health Bureau, Ministry of Healthcare Nutrition, Colombo, Sri Lanka 2009.
23. Gunaratna KA, Goonewardene M. Teenage pregnancy and contraception. Sri Lanka J Obstet Gynaecol 2001;23:15-19.
24. Goonewardene Malik, Deeyagaha Waduge RPK. The adverse effects of teenage pregnancy. Ceylon Med J 2005;50 (iii): 116-20.
25. Fernando N, Perera B, Fernando N, Goonewardene M, Ostbye T. Factors associated with sexual behaviour among Sri Lankan Adolescents. Galle Medical Journal 2009;14(1):39-44.
26. Vithanachchi TVK, Goonewardene Malik. Intraumbilical vein oxytocin: A management option for retained placenta. Sri Lanka J Obstet Gynaecol 2005;27:23-28.
27. Goonewardene Malik, Batcha TM. The fetal acoustic stimulation test: A reliable and cost effective method of antepartum fetal monitoring. Ceylon Med J 2005;50(iv):156-159.
28. Goonewardene M, Hanwellage K. Fetal acoustic stimulation test for early intrapartum fetal monitoring. Ceylon Med J 2011; 56(i):14-18.
29. Chwalisz K, Garffield RE. Nitric oxide as the final mediator of cervical ripening. Human Reproduction 1998;13:245-52.
30. Kelly AJ, Kavanagh J. Nitric oxide donors for cervical ripening and induction of labour. Cochrane Database of Systematic Reviews 2008, Issue 1. Art no. CD006901, DOI: 10.1002/14651858.CD006901.
31. Bertran AP, Merialdi M, Lauer JA, Bing-Shun W, Thomas J, Van Look P, Wagner M. Rates of caesarean section: Analysis of global, regional and national estimates. Paed Perinat Epid 2007;21(2):98-113.
32. Villar J, Valladares E, Wojdela D, Zavaleta N, Carroli G, Velazco A, et al. WHO 2005 global survey on maternal and perinatal health research group. Caesarean delivery rates and pregnancy outcomes: The 2005 WHO global survey on maternal and perinatal health in Latin America. Lancet 2006;367(9525): 1796-97.
33. Robson MS. Can the high caesarean section rates be reduced? In: Recent Advances in Obstetrics and Gynaecology. Bonar J, Dunlop W (Eds). The Royal Society of Medicine Press Ltd. London 2004;71-84.
34. Robson MS, Scudamore IW, Walsh SM. Using the medical audit cycle to reduce caesarean section rates. Am J Obstet Gynaecol 1996;174(1):199-206.