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Original Article

Comparison of Manual Fetal Stimulation vs. No Fetal Stimulation on Non-Reassuring CTG during Intrapartum Fetal Surveillance

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ABSTRACT

Objective: To compare the effectiveness of manual fetal stimulation versus no fetal stimulation in managing non-reassuring Cardiotocography during intrapartum fetal surveillance.

Study Design: Quasi-experimantal study

Place and Duration of Study: Department of Obstetrics & Gynaecology, Pak Emirates Military Hospital, Rawalpindi Pakistan from Jan 2023 to Mar 2024.

Methodology: In this study, n=242 patients were allocated randomly to either the manual fetal stimulation and Cardiotocography group or the no fetal stimulation and Cardiotocography group. The Inclusion criteria were women with singleton pregnancy at a gestation length of 37 weeks or more with non-reassuring Cardiotocography findings. The main parameters studied were the fetal heart accelerations, mode of delivery, Apgar score at the fifth minute, cord blood lactate level and admission to the neonatal intensive care unit.

Results: Significantly higher number of patients (94.22%) showed fetal heart acceleration in the manual fetal stimulation group as compared to the no fetal stimulation group (80.17%). In the manual fetal stimulation group, 31.40% of the women underwent caesarean delivery compared to 37.19% in the no fetal stimulation group; however, the difference was not significant. Apgar score at 5th minute, cord blood lactate level and number of babies admitted to neonatal intensive care unit was also not different between the groups (p>0.05).

Conclusion: Significantly higher number of cases having non-reassuring Cardiotocography showed the acceleration in fetal heart rate in response to manual fetal stimulation as compared to those not given this treatment. However, maternal and fetal outcomes were not different between the treatments.

Keywords: Apgar Score, Cardiotocography CTG, Caesearen, Cord Blood Lactate, Manual Fetal Stimulation, Non-Reassuring.

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INTRODUCTION

In the realm of obstetrics and intrapartum care, the assessment and management of fetal well-being during labour are pivotal in ensuring positive maternal and neonatal outcomes. In this context, the utilization of continuous electronic fetal monitoring, particularly Cardiotocography (CTG), has become a standard practice (Wattar *et al*.).[1] Abnormalities of fetal heart rate may indicate a number of obstetric conditions of maternal or fetal origin affecting the functioning of the feto-maternal blood circulation resulting in poor fetal oxygenation (Gravett *et al*.).[2] Presumably, the most important factor responsible for non-reassuring fetal CTG is oxygen deprivation with or without metabolic acidosis. However, such abnormal fetal heart findings have a poor ability to predict a compromised fetus (Rathore *et al*.)[3] and in many cases of non-reassuring or abnormal CTG findings the fetus responds physiologically to a stress stimulus and continues normally in labour (Murphy *et al*.).[4] High false-positive rates of non-reassuring CTG findings result in a prompt surgical intervention to enhance fetal oxygenation and remain associated with a higher number of caesarean and instrumental deliveries unnecessarily which has adverse effects on mother's health in days to come (Alfirevic *et al*.).[5] Manual fetal stimulation either accelerates or increases baseline fetal heart rate by activating the physiological autonomic nervous system which is compromised in case the fetus is acidemic. Hence presence or absence of acceleration and variability in response to fetal stimulation can be used as an intermediate test to predict fetal acidosis level. Therefore addition of the fetal stimulation test may be used as an adjuvant to CTG to reduce false-positive findings and serve as an appropriate guide for decision-making regarding surgical intervention or continuing in labour. Various types of fetal stimulation tests are in practice;

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however, manual fetal stimulation is simple, less painful being non-invasive, does not require any instrument and is doable in all setups. This research endeavours to delve into the comparative efficacy of manual fetal stimulation versus the absence of such stimulation in the context of non-reassuring CTG during intrapartum fetal surveillance as well as to evaluate the fetal and maternal outcomes of these applications.

Scrutiny of the impact of these two approaches is likely to contribute to the guideline for refining clinical practices to optimize fetal well-being in labouring mothers.

METHODOLOGY

This quasi-experimantal study was carried out at the Department of Obstetrics & Gynaecology, Pak Emirates Military Hospital, Rawalpindi Pakistan from 15th January 2023 to 15th March 2024 after seeking approval vide number CPSP/REU/OBG-2021-124-10954 dated 27 August 2022. Formal ethical approval was obtained from the hospital ethical review committee vide number A/28/ERC/619/23. The sample size was calculated using WHO sample size calculator taking the confidence interval of 95%, the margin of error of 5% and reported caesarean rate of 19.5 % in view of non-reassuring CTG (Paladugu *et al*.).[6] The estimated sample size came out to be 242 patients.

Inclusion Criteria: Pregnant women in labour, aging 20-45 years, with singleton pregnancy at a gestation length of 37 weeks or more having cephalic presentation of fetus, with non-reassuring CTG findings. Cardiotopographic findings were considered non-reassuring if the baseline fetal heart rate was less than 110 beats or more than 160 beats per minute, with minimal or absent beat-to-beat variability and variable or late decelerations. Informed consent of the patients was obtained before inclusion in the study.

Exclusion Criteria: Patients with pregnancy less than 37 weeks, having a history or current indication of emergency caesarean section, known abnormal uterine conditions or intrauterine dead fetus were excluded from the study. Patients having a history of serious medical issues like clotting disorder, deranged hepatic profile, chronic renal failure and fetal congenital malformations were also excluded.

The included patients were examined clinically, detailed history recorded, followed in labour and allocated randomly to either the manual fetal stimulation (MFS) and CTG group or the no fetal stimulation (NFS) and CTG group. Randomization was carried out on the basis of an identification number allotted to each eligible patient in the order of reporting. Odd numbers were assigned to MFS and even numbers to NFS group. Cardiotocography was performed and interpreted in the light of guidelines provided by Ayres *et al*.[7] Doppler ultrasound transducer was used to monitor and record fetal heart rate changes externally. Both groups had 121 patients each. After baseline fetal heart rate tracing, for MFS treatment, the procedure described by Tan *et al*.,[8] was followed. Briefly, the examiner grasped the presenting part and upper pole of the fetus through the mother's abdomen and gently moved it left and right, up and down, and forward and backwards. Each movement was performed twice. Subsequently where possible fetal scalp was gently rubbed through the vagina with the examining fingers for 30 seconds (Macones *et al*.).[9] Fetal heart rate was then recorded as an outcome. For the NFS group fetal heart rate was recorded after holding the fetus in the same position through the maternal abdomen as a mock activity but without moving it. If no acceleration in fetal heart rate was noticed within 20 minutes, the stimulus was repeated. If more than two accelerations of 15 beats per minute in amplitude and staying more than 15 seconds but less than ten minutes were noted within a period of 40 minutes, the stimulus was considered reactive failing which it was declared non-reactive. In the absence of acceleration, caesarean section or other interventions were decided accordingly. The main parameters studied were decision regarding mode of delivery, Apgar score at the fifth minute, cord blood lactate level and admission to neonatal intensive care unit (NICU) and time taken to get discharged. The mode of delivery was categorized as caesarean section and vaginal birth. Five components of the Apgar score (skin colour, heart rate, muscle tone, reflex irritability and respiratory effort) were measured by the attending neonatologist. Total scores ranged from 0-10. A fifth-minute Apgar score from 7 to 10 was considered normal and <7 was taken as a study parameter (Cnattingius *et al*.).[10] For cord blood lactate analysis a double clamp was applied to the umbilical cord and arterial blood was drawn into vacationer tubes with potassium oxalate as anticoagulant in duplicate and the samples were immediately sent to the laboratory where lactate level was determined with an automatic blood gas analyser (Gjerris *et al*.).[11] The blood lactate value of less than 3.90 mmol/L was

suggested to be the optimal cut-off and more than 4.63mmol/L was considered to be indicative of metabolic acidosis (Tuuli *et al.*).[12] Mothers and their babies were closely monitored in the hospital until discharged fit.

Data was entered in an Excel sheet for subsequent analysis in the software "Statistical Package for Social Sciences" (SPSS). Categorical data like the presence or absence of reactivity and Apgar score less than seven were expressed as descriptive statistics through frequency and percentile. Continuous variables like cord blood lactate level were recorded as means and standard deviation and analyzed through independent sample t-test. To determine the association between manual fetal stimulation and consequent CTG as well as fetal and maternal outcome data collected were cross-tabulated and subjected to statistical analysis under the Chi-square test. All results were considered significant at $p \leq 0.05$.

RESULTS

We recorded data of n=242 patients during our study period out of which 121 women each were randomly assigned to either the MFS or NFS group. The means of age of the women included in our study were 29.71±5.71 and 29.17±5.22 years in the MFS and NFS groups respectively which were not different between the two groups (p=0.49). Means of gestation period of subjects at delivery were 279.52±4.19 and 279.63±3.52 days in MFS and NFS groups respectively which were also statistically not different between groups (p=0.88). Parity in both groups ranged from 0 to 3. Results of fetal heart acceleration response have been presented in Table-I. Significantly (p=0.002) higher number of patients (94.22%) showed fetal heart acceleration in the MFS group as compared to the NFS group (80.17%). Table-II shows the effect of manual fetal stimulation on the mode of fetal delivery. In the MFS group, 31.40% of the women underwent operative delivery through caesarean as compared to 37.19% in the NFS group. Although the number of caesarean sections was lower in the MFS group than NFS group, however, the difference was not significant (p=0.42). There was no significant difference between the groups in Apgar score at the 5th minute and the number of babies admitted to the neonatal intensive care unit (Table-III, p=0.25 and p=0.49 respectively). Only 2.48% of the cases in the MFS group had Apgar score of less than seven at the fifth minute versus nil in the NFS group. From the manually stimulated group, 6.61% of the babies needed admission to NICU as compared to 9.92% in the no-stimulation group. The Means±SD of continuous variables like fifth minute Apgar score, cord blood lactate and days admitted in NICU have been presented in Table-IV. All these parameters were also significantly not different between the two groups (p>0.05). The mean 5th-minute Apgar score in the MFS group was 8.19±0.83 (range 6-10) and that in the NFS group was 8.12±0.60 (range 7-10). The mean values for cord blood lactate level in the MFS and the NFS group remained 3.84±0.57 (range 2.60-8.00) and 3.87±0.44 (range 2.75-4.65) mmol/L respectively. The means of days spent in NICU were 0.14±0.47(range 0-2) and 0.18±0.53 (range 0-3 days) in the MFS and NFS groups respectively. No perinatal death was recorded in any of the groups, therefore no analysis could be performed for this outcome.

Table-I: Effect of Manual Fetal Stimulation on Fetal Heart Acceleration on CTG (n=242)

Baseline Characteristics		Treatment		Total	*p*-value
		MFS (n=121)	NFS (n=121)		
Fetal heart acceleration	Present	114(94.22%)	97(80.17%)	211(87.19%)	0.002
	Absent	7(5.78%)	24(19.83%)	31(12.81%)	
Total		121(100%)	121(100%)	242(100%)	

MFS(Manual fetal stimulation, NFS(No fetal stimulation).

Table-II: Effect of Manual Fetal Stimulation on the Mode of Fetal Delivery (n=242)

Baseline Characteristics		Treatment		Total	*p*-value
		MFS (n=121)	NFS (n=121)		
Fetal delivery	Ceasarean section	38(31.40%)	45(37.19%)	83(34.30%)	0.42
	Vaginal	83(68.60%)	76(62.81%)	159(65.70%)	
Total		121(100%)	121(100%)	242(100%)	

MFS (Manual fetal stimulation), NFS (No fetal stimulation)

Table-III: Effect of Manual Fetal Stimulation on Fetal Outcomes (Categorical) (n=242)

Baseline Characteristics		Treatment		*p*-value
		MFS (n=121)	NFS (n=121)	
Apgar Score <7 at 5th minutes	Yes	3 (2.48%)	0(0%)	0.25
	No	113(97.52%)	100(100%)	
Total		121(100%)	121(100%)	
Admission to Neonatal ICU	Yes	8(6.61%)	12(9.92%)	0.49
	No	113(93.39%)	109(90.08%)	
Total		121(100%)	121(100%)	

MFS (Manual fetal stimulation, NFS (No fetal stimulation)

DISCUSSION

If a fetus responds to a stimulus through acceleration in heart rate, it indicates that its autonomic nervous system is intact which otherwise gets compromised in case of acidemia. In our study, a 14% higher number of cases showed reassurance

through positive acceleration in fetal heart rate after manual fetal stimulation as compared to those not given this treatment which was a highly significant difference (p<0.01). These findings are in line with the number of previous studies (Tan *et al*.).[8] The positive reactivity seen in the current trial closely matches with Piyamongkol *et al*.,[13] who also reported 98.9% reactive cases to manual stimulation as compared to 84.4% in non-stress group. In the same context, Shakouri *et al*.,[14] also assessed the validity of fetal scalp stimulation and consequent acceleration provoked. The said study found a positive correlation between the fetal capacity to react with its well-being in terms of better metabolic profile, however, they questioned the efficacy of the fetal stimulation test declaring it less specific. Fetal heart rate acceleration and/or variability seen in response to fetal stimulation in patients having non-reassuring CTG has also been described to have a positive correlation with fetal blood sampling, a reliable test to reduce unnecessary interventions and operative deliveries (Tahir *et al*.).[15] A review of eleven articles Skupski *et al*.,[16] also suggested digital fetal stimulation as the easiest test to predict the acidemic level of the fetus shown by the presence or absence of an acceleration in response to the stimulation when non-reassuring CTG patterns are appearing. Another study by Rathore *et al*.,[3] reported non-reactive fetal stimulation to be strongly correlated with adverse outcomes in neonates like low Apgar score and low cord blood PH as well as asphyxia. The same study described a 44% positive (absence of reactivity) and 83% negative (presence of reactivity) predictive value of fetal stimulation test for diagnosis of fetal acidemia which can help to make an accurate decision to go for surgical delivery or continue with labour in non-reassuring cases. Contrasting results were reported by an earlier study on the subject carried out by Druzin *et al*.[17] which found no significant difference between manual stimulation and non-stimulation with respect to fetal heart rate reactivity. The possible reason could be the procedure adopted for manual stimulation, its intensity (less vigorous in this study) and repetitions. The caesarean rate in patients of our study who received manual fetal stimulation was 5.79% lower than the patients who did not receive it, however; the analysis could not reach a significant level. It is pertinent to mention here that non-reassuring CTG findings were not the sole reason leading to the decision regarding surgical intervention. The Apgar score, cord blood level and admission days in NICU of our study were also not different between treated and untreated patients. A later review article Tan *et al*.,[8] described a non-significant lower incidence of non-reactive CTG as well as less time to reach a reactive stage in patients given manual fetal stimulation in labour as compared to those who received no stimulation or mock stimulation. The statistical analysis of our data revealed that our findings regarding maternal and fetal outcomes are in agreement with the latest review by Murphy *et al*.,[4] and quite recent studies carried out by Hughes *et al*.,[18] and Tahmina *et al*.[19] Although a significantly higher reactivity in response to fetal stimulation was seen in our study, it could not be verified by other maternal and fetal outcomes. Therefore it cannot be relied upon as an exclusive test to rule out or rule in acidemia due to less specificity and as a precaution other complementary diagnostic tools would also be required. The findings suggest that manual fetal stimulation test has the potential to reduce operative deliveries, however further studies are required to establish its significance or otherwise.

Table-IV: Effect of Manual Fetal Stimulation on Fetal Outcomes (Apgar Score, Cord Blood Lactates and Days in Neonatal ICU) (Continuous) (n=242)

Variable	Treatment		*p*-value
	MFS (n=121)	NFS (n=121)	
Apgar score at 5th minute (Mean±SD)	8.19±0.83	8.12±0.60	0.48
Cord blood lactate level (mmol/L) (Mean±SD)	3.84±0.57	3.87±0.44	0.58
Days admitted in ICU (Mean±SD)	0.14±0.47	0.18±0.53	0.52

MFS (Manual fetal stimulation, NFS (No fetal stimulation)

Table-V: Effect of Manual Fetal Stimulation on Fetal Outcomes (Days in Neonatal ICU) (n=242)

Number of days	Number of babies	
	MFS (n=121)	NFS (n=121)
0	110	106
1	5	9
2	6	5
3	0	1

MFS (Manual fetal stimulation, NFS (No fetal stimulation)

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CONCLUSION

A significantly higher number of cases having non-reassuring CTG showed the acceleration in fetal heart rate in response to manual fetal stimulation as compared to those not given this treatment. However, maternal and fetal outcomes were not different between the treatments.

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Authors' Contribution

Following authors have made substantial contributions to the manuscript as under:

AF & TY: Data acquisition, data analysis, critical review, approval of the final version to be published.

SFC & RA: Study design, data interpretation, drafting the manuscript, critical review, approval of the final version to be published.

MT & TAK: Conception, data acquisition, drafting the manuscript, approval of the final version to be published.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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