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RESEARCH ARTICLE

OUTCOMES AND ASSOCIATED FACTORS OF BABIES DIAGNOSED WITH MECONIUM ASPIRATION SYNDROME (MAS): A CASE CONTROL STUDY

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Abstract

Introduction: Meconium aspiration syndrome (MAS) is an illness that linked with significant respiratory morbidity among neonates born through meconium-stained amniotic fluid (MSAF). MAS, the most common cause of serious sickness and death in newborns, occurs in around 5% to 10% of births. 6–25% of all babies have "meconium-stained amniotic fluid (MSAF)," and approximately 11% will have MAS. This case-control study examines the outcomes and factors associated with MAS in babies born with MSAF.

Methods: This single-center case-control study was performed in Kalkaal Hospital from December 15, 2020 to December 15, 2021. The hospital review board of the examined and approved the research protocol. During this period 430 neonates were admitted to the Neonatal Intensive Care Unit (NICU) in the Hospital. Among the 430, 63 neonates had Meconium aspiration syndrome and were included as the case group in the study. 63 neonates without meconium-stained amniotic fluid or meconium aspiration syndrome were selected purposively for the study. In both groups a record was made on information about fetal distress, gestational age of baby and delivery mode. Additionally, complications like prolonged duration of labor, obstructed labor, and presence of premature rupture of membrane (PROM), and maternal age were recorded.

Results: 50.8% of the neonates born with meconium-stained amniotic fluid were males, while 49.2% were females. 61 of the MAS neonates were still alive, while two had expired while all of the control groups were alive. The variables that showed to have significant effect on MAS include fetal distress($p<0.000$), gestational age greater than 42 weeks ($p = 0.01$), and obstructed labor ($p = 0.023$). The results of the study indicates that 66.7% (n=42) of the patients in the case group had fetal distress with a odds ratio of 19, gestational age above 42 weeks in the case group were 31.7% with a odds ratio of 3.19 and 27% (n=17) of the patients had obstructed labor with a odds ratio of 2.96.

Conclusion: The research found out that fetal distress, gestational age greater than 42 weeks, and obstructed labor all contribute significantly to meconium aspiration. Identification and screening of these risk factors may assist in the care of patients with meconium aspiration,

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therefore minimizing MAS-related complications, morbidity, and death.

Introduction:-

Meconium aspiration syndrome (MAS) is an illness that linked with significant respiratory morbidity among neonates born through meconium-stained amniotic fluid (MSAF). Meconium aspiration syndrome, the most common cause of serious sickness and death in newborns, occurring in around 5% to 10% of births. 6–25% of all babies have "meconium-stained amniotic fluid," and approximately 11% will have MAS [1]. While the exact cause remains unidentified, meconium is believed to be passed from the fetal gastro-intestinal tract in response to hypoxia, mesentric vasoconstriction-induced gut hyperperistalsis, declining umbilical venous saturation, vagal stimulation, and normal physiological function of the mature fetus[1–3].

MAS is a frequently occurring problem encountered by pediatricians in the birth room and in newborn nursery[4]. The outcome of MAS is mostly contingent on the type, quantity of meconium aspiration, and the perinatal care provided to the infant during labor. Proper perinatal treatment and coordinated team, approach to neonates with MSAF have significantly reduced the morbidity and mortality associated with MAS[5].

Inconsistent results have been observed in labors affected by meconium staining of the amniotic fluid, with the severity of the aspiration variable. Studies have shown that, factors like prolonged labor, infection during delivery, an abnormal fetal heart rate, or problems with umbilical blood supply may result in fetal distress which leads to MAS[3]. Additionally, it has been reported that the risk of meconium aspiration syndrome increases with gestational age in patients with MSAF[6]. Apart from the presence of meconium, several variables associated with late-term and post-term pregnancy may contribute to the genesis of MAS. Other aspects that have been linked with MAS include the obstructed labor, presence of PROM, maternal illness, and maternal age[6].

MSAF is known to be associated with plethora of unfavorable fetal outcomes yet to our knowledge there is little to no significant data in our knowledge on meconium staining in Somalia. Therefore, this case-control study seeks to contribute to the literature by examining the outcomes and factors associated with MAS in neonates born with MSAF.

Methods:-

Study design and Setting:

This single-center case-control study was performed in Kalkaal Hospital from December 15, 2020 to December 15, 2021. Kalkaal Hospital is a multispecialty hospital located in Hodan District, Banadir Region, Mogadishu City, in Somalia.

Study participants and variables:

Overall, 126 neonates were included in the study. 63 neonates who had been born with meconium-stained liquor were included in the case group. 63 neonates without meconium-stained liquor were selected purposively for the study and included in the control group.

Definitions and Diagnostic approach:

Meconium-stained liquor is described as the presence of meconium-stained amniotic fluid that causes the fluid to appear greenish or yellow in color. The newborns were diagnosed with MAS based on the presence of MSAF in the trachea as established by suction and supported by chest X-rays showing pulmonary hyperinflation with multiple opacities and flattening of the diaphragm. The inclusion criteria were neonates admitted to the NICU, who had been sick from birth, less than 28 days old, and those with a gestational age more than 37 weeks. Exclusion criteria included patients who were Meconium-positive and refused admission, as well as those who were older than 28 days.

Ethical approval:

The review board of the hospital examined and approved the research protocol and informed consent was obtained from the parents of eligible candidates prior to inclusion.

Data sources and Handling Bias:
MSAF was diagnosed in infants during labor or delivery at Kalkaal Hospital's delivery unit. A predefined questionnaire was used as the data collection tool. In both groups a record was made on information about fetal distress, gestational age of baby and lower uterine Caesarean section (LUCS) delivery mode and maternal age. Additionally, complications like prolonged duration of labor, obstructed labor, and presence of premature rupture of membrane (PROM) were recorded. A record of specific maternal illnesses including diabetes mellitus, and hypertension were included in the research data.

Data analysis:
To determine the outcomes and risk variables related with meconium aspiration in newborns, descriptive statistics and odds ratios were computed using Microsoft Excel (Office 13) and the Statistical Package for Social Science (SPSS) version 25. The threshold for statistical significance was set at $p < 0.05$.

Results:-

Patient Demographic characteristics
Overall, as shown in table1, the study included a total of 126 neonates, 63 of whom were in the case group and had MAS at delivery, and similarly the control group were 63 neonates without MAS at birth. 50.8% of the neonates born in the case group were males, while 49.2% were females. 61 of the neonates with meconium aspiration were still alive, while two had expired. All neonates in the control groups were discharged alive.

The gestational age of the majority of the studied patients was between 37 to 42 weeks. Majority of the term babies (57.47%, n=50) did not have meconium aspiration accounting 37 babies. There were only 10 preterm babies' majority (60.00%, n=6) being without MAS. On the other hand, majority of the neonates with gestation age being post-term (75%) had meconium aspiration accounting for 22 babies.

Meconium Status of the studied patients
Figure 1 depicts the distribution of the patients studied in terms of meconium condition and severity of the patients. According to the findings, 50 percent of the patients (n = 63) did not have meconium aspiration, 38 percent (n = 48) had mild meconium aspiration, and 12 percent (n = 15) had severe meconium aspiration, as shown in Figure 1.

Outcomes and Risk Factors
The main variables consisting of the outcomes and risk factors associated with MAS is as shown in table 2. The results of the study indicates that 66.7% (n=42) of the patients in the case group had fetal distress with a odds ratio of 19, compared to 9.5% (n=6), of the patients in the control group who had the condition. Furthermore, the study indicates a statistically significant difference between case and control group in regard to fetal distress, $p<0.000$.

The case group had 31.7 percent of patients with a gestational age greater than 42 weeks, with an odds ratio of 3.19, compared to 12.7 percent in the control group. Furthermore, with $p = 0.01$, there was a statistically significant difference between the case and control groups in terms of the patient's gestational age.

There was no statistically significant difference ($p>0.05$) between the case and control groups in terms of delivery type, prolonged labor, presence of PROM, presence of maternal illness, and maternal age. However, there were more patients in the case group who delivered by CS, 68.3 percent, compared to 60.3 percent in the control group. Similarly, 36.5 percent of patients had prolonged labor, compared to 23.8 percent in the control group. The case group had 28.6% of patients over the age of 30, while the control group had 17.5%.

The result of the data indicates that 27 percent (n=17) of the case group patients had obstructed labor with a odds ratio of 2.96 whereas the control group were 11% (n=7). Moreover, the results indicate a statistically significant difference between the two groups $p = 0.023$.

Discussion:-

The findings on outcomes and risks factors of meconium aspiration syndrome in this study were compared with the findings of other relevant studies that have been published. The demographic data indicates no statistically significant difference between the case group and the control group.

In total, 38% of all the study neonates had fetal distress. The study's findings reveal a statistically significant difference in fetal distress ($p < 0.000$) between the case group and the control group. 66.7 percent of patients in the case group experienced fetal distress with an odds ratio of 19. The vast majority of patients in the control group, 90.5 percent, did not experience fetal. In another study, [7], the authors reported a proportion of 30% of all the study neonates on fetal distress. The authors found a statistically significant result that 65.8% of the study patients in the case group experienced fetal distress at birth, compared to only 3.9 percent in the control group with a very high odds ratio of 48. In a study of 136 newborns, Salman and colleagues found that 67 percent of MAS neonates suffered fetal distress[4]. The association between fetal distress and MSAF has been reported in many studies[8]. Shukla and Swapna's observed that 23.7 percent of patients with the MSAF exhibit fetal distress [9].

Changes in the Fetal Heart Rate (FHR), most commonly bradycardia, and meconium passing as a result of underlying fetal hypoxia are characterized as fetal distress [10]. When a newborn is distressed, the oxygen level in the blood drops, causing hyperactive bowels. The infant's anal sphincter relaxes, allowing meconium to pass. The meconium is then absorbed by the amniotic fluid that surrounds the newborn [10]. Exposing the fetus tomeconium stained amniotic fluid increases the chances for to meconium aspiration syndrome.

There was a statistically significant difference in terms of the patient's gestational age ($p = 0.01$ between the case and control groups) and the odds ratio of 3.19. Additionally, the study shows that, gestational age above 42 weeks in the case group were 31.7% while the control group were 12.7%. This study shows that, a higher proportion of patients with gestational age greater than 42 are likely to have MAS. Other studies have shown similar trends that important risk factors for MAS were found to include post-maturity in 12 percent of cases[4,6]. According to John and colleagues, MAS is common in the presence of fetal distress and a pregnancy that has progressed to or beyond 42 weeks of gestation[11].

The results indicate a statistically significant difference between the case and control groups in terms of the occurrence of obstructed labor ($p = 0.023$). The outcome of the data reveals that patients in the case group experienced obstructed labor at a rate of 27%, compared to 11% in the control group. The odds ratio for having an obstructed labor in the case group was 2.96. However, a study by Rashid et al (2021) showed no statistically significant results in the occurrence of obstructed labor between MSAF patients and non MSAF patients[7]. The findings of this study are consistent with a study by authors Addisu, Asres, Gedefaw and SimegnewAsmer. According to their, the risk of developing MSAF was 5.9 times greater in obstructed labor than in unobstructed labor. According to the authors' research, the risk of developing MSAF was 5.9 times greater in obstructed labor than in unobstructed labor. The cause might be that maternal dehydration, distress, or shock may result in intrauterine fetal hypoxia as a consequence of inadequate placental perfusion, followed by meconium passing into the amniotic fluid[12].

The findings indicated that there was no statistically significant difference in the method of delivery with 68.3% and 60.3% patients in the case group and control group respectively. However, unlike this study Rashid R, et al findings indicated a statistically significant difference in delivery type. Similarly, in Wisam A. et al in a study on MAS, there was a significant different between MAS patients and non-MAS patients in terms of the type of delivery, particularly caesarean section (CS) was reported as a significant factor for MAS[13].

The results in this study shows more patient in the case group compared to control group for a prolonged labor. However, there was no statistically significant difference between the two groups. According to a study by authors Addisu D, Asres A, Gedefaw G and Asmer S there was a statistically significant difference between patients with MSAF and those without MSAF in regard to the duration of labor. The authors gives and explanation that this could result from a prolonged stressful environment for the fetus that triggers gastrointestinal tract peristalsis and relaxation of the anal sphincter allowing meconium pass. This could explain the reason for higher number of patients with prolonged labor in the case group compared to the control group. Just like in the results of this study, another study by Rashid R, et al indicates that there is not statistically significant association between MAS and non-MAS patients in terms of existence of PROM, presence of maternal illness, or maternal age between the case and control groups[7].

Since the research was done at a single hospital, the findings may not be reflective of other institutions or the general population. Additionally, due to the constraints inherent in case control research, it may be impossible to establish a

temporal link between MSAF and explanatory factors in this study. Additionally, another problem is that recall bias may exist when assessing gestational age.

Conclusion:-

The research found out that fetal distress, gestational age greater than 42 weeks, and obstructed labor contribute significantly to meconium aspiration during delivery. Identification and screening of these risk factors may assist in the care of patients with meconium aspiration, therefore minimizing MAS-related morbidity, and mortality.

What is already known on this topic

1. Somalia has one of the world's highest newborn death rates and Meconium aspiration syndrome (MAS) is an illness that linked with significant respiratory morbidity among neonates born through meconium-stained amniotic fluid (MSAF).
2. There has been decline in MAS-related morbidity and mortality in developed countries
3. The identification and screening of risk factors will help in reducing MAS-related complications and mortality.

What this study adds

1. This is the first study to investigate at the risk variables for MAS-related complications and mortality in sick newborns in a hospital neonatal unit in Mogadishu, Somalia.
2. There is significantly high number of infants diagnosed with MAS having fetal distress, post term gestational age, and obstructed labor during delivery.

Competing interests

The authors declare no competing interest.

Authors' contributions

Dr. Jibril Abdi Malinand Dr. Suleyman Abdullahi Mohammed contributed to all parts of the study; Mr. Timothy Kimutai contributed to the design, analysis and interpretation of data and drafting and revising the manuscript.

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Tables and figures

Table 1:- Patient Demographic characteristics.

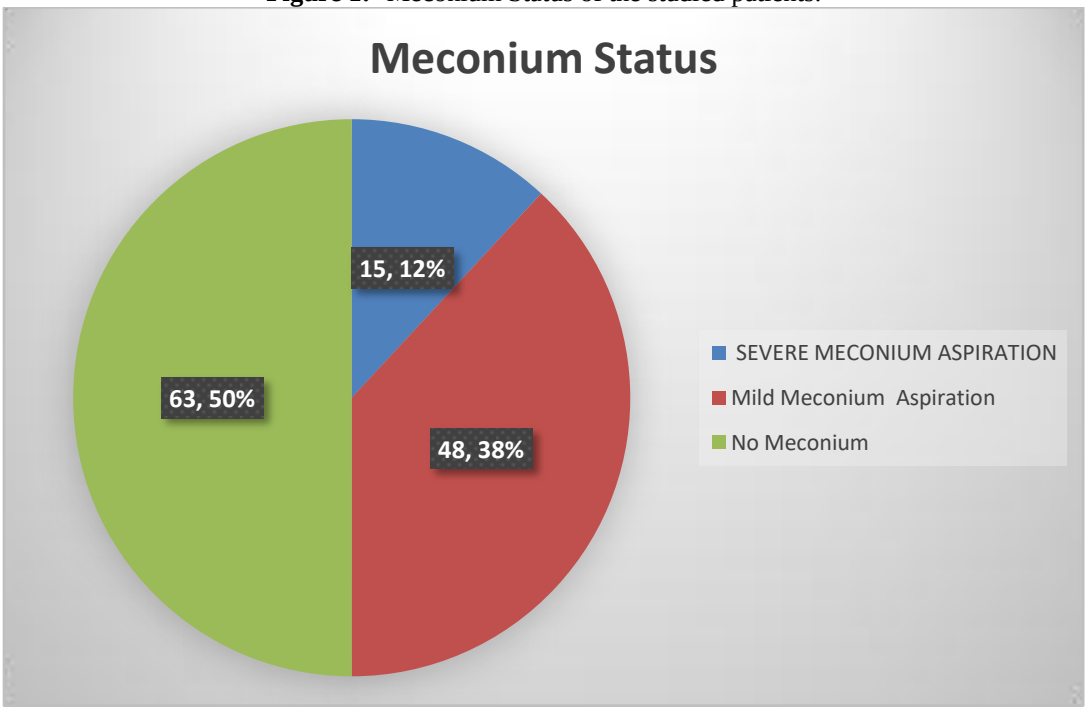
Meconium Aspiration and Gender				
		Meconium Aspiration	**No Meconium Aspiration**	**Total**
Gender	MALE	32(50.8%)	40(63.5%)	72(57.1%)
	FEMALE	31(49.2%)	23(36.5%)	54(42.9%)
	Total	**63(100%)**	**63(100%)**	**126(100%)**
Meconium Aspiration and Alive/Died				
		Meconium Aspiration	**NoMeconium Aspiration**	**Total**
Discharged	Alive	61	63	124
	Died	2	0	2
Meconium Aspiration and Gestational age				
		Meconium aspiration	**No Meconium aspiration**	**Total**
Gestational age	PRE-TERM (less than 37 weeks)	4(40.00%)	6(60.00%)	**10(100%)**
	TERM (between 37 to 42 weeks)	37(42.53%)	50(57.47%)	**87(100%)**
	POST TERM (more than 43 weeks)	22(75.86%)	7(24.14%)	**29(100%)**

Maternal Illness	Present	3(4.8%)	4(6.3%)	**7**
	Absent	60(95.2%)	59(93.7%)	**119**

Table 2:- Outcomes and Risk Factors Studied.

Risk Factors		Meconium Aspiration Status		Odds Ratio	P- value
		MAS	No-MAS		
Fetal Distress	Present	42(66.7%)	6(9.5%)	19	<0.000
	Absent	21(33.3%)	57(90.5%)		
Gestational Age	>42	20(31.7%)	8(12.7%)	3.19	0.01
	<42 or =42	43(68.3%)	55(87.3%)		
Delivery Type	CS	43(68.3%)	38(60.3%)	1.41	0.353
	Normal	20(31.7%)	25(39.7%)		
Prolonged labor	YES	23(36.5%)	15(23.8%)	1.84	.12
	NO	40(63.5%)	48(76.2%)		
Obstructed labor	YES	17 (27%)	7(11.1%)	2.96	0.023
	NO	46 (73%)	56(88.9%)		
PROM	YES	25(39.7%)	24(38.1%)	1.06	.855
	NO	38(60.3%)	39(61.9%)		
Maternal Illness	YES	3(4.8%)	4(6.3%)	0.74	0.697
	NO	60(96.2%)	59(93.7%)		
Maternal Age	>30	18(28.6%)	11(17.5%)	1.89	0.138
	≤30	45(71.4%)	52(82.5%)		

Figure 1:- Meconium Status of the studied patients.



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