

Original article

Adverse Perinatal Outcomes in Term Pregnancies Complicated by Borderline Oligohydramnios: A Retrospective Cohort Study

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Abstract

The objective of this analysis was to assess whether adverse pregnancy outcomes at term differ between pregnancies categorised by ultrasound amniotic fluid volume as borderline low, low, or average. This study was designed as a retrospective cohort study during 2021–2025, comparing singletons born at term (37–42 weeks) whose mothers had an ultrasound evaluation of their amniotic fluid volume during the final week before birth. The investigators identified those whose ultrasounds indicated borderline amniotic fluid volume (5.1–8.0 cm AFI), low amniotic fluid volume (≤ 5.0 cm AFI), and those whose ultrasounds showed them to have a normal amniotic fluid volume (8.1–25.0 cm AFI). The investigators then randomly selected controls from the last group (those with ultrasounds indicating a normal amniotic fluid volume) to match each case in the first two groups. Cases with ultrasounds before the third trimester, cases with rupture of membranes after 32 weeks gestation, cases with multiple fetuses, and cases with a major maternal or fetal condition were eliminated. The main outcomes were small-for-gestational-age (SGA) infants and caesareans performed due to fetal distress. Additionally, a composite measure of adverse neonatal outcome was analysed. Multivariate logistic regression models were used to examine associations. A total of 622 pregnant women were studied (142 borderline oligohydramnios, 338 oligohydramnios, 142 controls). SGA neonates occurred more frequently in both the borderline and oligohydramnios groups compared to controls (11.3% and 11.2% respectively, vs 3.5%, $p = 0.022$), as well as caesarean deliveries for fetal distress (16.2% and 13.0% respectively, vs 4.9%, $p = 0.009$) and the combined measure (31.7% and 26.9% respectively, vs 16.9%, $p = 0.013$). Borderline oligohydramnios was independently associated with an SGA neonate (adjusted OR [aOR] 3.92, 95% CI = 1.35–11.38; $p = 0.012$) and with caesarean delivery for fetal distress (aOR 3.55, 95% CI = 1.34–9.42; $p = 0.011$). Rates of meconium-stained amniotic fluid, chorioamnionitis, overall caesarean delivery, and NICU admission did not differ significantly. Borderline oligohydramnios at term is associated with an increased risk of an SGA neonate and of caesarean delivery for fetal distress, approaching the risk seen with overt oligohydramnios. These pregnancies may warrant heightened fetal surveillance.

Keywords. Borderline Oligohydramnios, Perinatal Outcome, Term Pregnancy.

Introduction

The amniotic fluid provides a cushioned, sterile, and temperature-stable space around the growing baby in the uterus; as well as acting to prevent infection, protect the baby from physical injury and promote movement necessary for development of muscles and bones, it also allows for normal functioning of the umbilical cord and supports normal development of the digestive system and lungs via swallowing and breathing of the amniotic fluid [1]. Through fetal urination and liquid secretion from the lungs, the amount of amniotic fluid that is produced increases throughout the second half of gestation until it reaches approximately 800 mL at birth. The amniotic fluid is then removed from the uterus via both swallowing by the fetus and through absorption into the membrane surrounding the fetus. This balance of producing and removing amniotic fluid is influenced by multiple factors, including those related to the placenta, mother and fetus. Therefore, due to its ability to be indirectly measured during an ultrasound examination, the level of amniotic fluid has come to be viewed as a "vital sign" of the status of the fetus [2]. If there is less than what would be expected based on gestational age, this condition is referred to as oligohydramnios.

Historically, this condition was believed to indicate either poor function of the placenta or poor health of the fetus. Furthermore, even in otherwise uncomplicated term pregnancies, oligohydramnios has been associated with an increased risk of adverse perinatal outcomes [3]. Amniotic fluid volume is usually estimated using ultrasound techniques that estimate either the sum of the deepest vertical pockets in each uterine quadrant (the amniotic fluid index [AFI]) or the single deepest vertical pocket (SDP). In many cases, these two methods are not interchangeable: one randomised trial compared use of the AFI to use of the SDP as methods for detecting oligohydramnios and found more pregnancies were identified by use of the AFI than with use of the SDP. Additionally, more inductions of labour were performed following use of the AFI than following use of the SDP, but no differences in maternal-perinatal outcome were observed [4]. Current guidelines recommend delivery between 36 weeks and 0 days through 37 weeks and 6 days gestation for all pregnancies diagnosed with oligohydramnios regardless of whether the pregnancy was complicated by maternal disease or fetal compromise [5]. There exists an intermediate category between clearly normal and obviously reduced amniotic fluid volumes known as borderline oligohydramnios, which most commonly refers to an AFI of 5.1 to 8.0 cm.

Unlike overt oligohydramnios, consensus does not exist regarding optimal antepartum surveillance and timing of delivery for this condition [6]. There is still considerable controversy about whether or how much a borderline oligohydramnios (borderline low) level of amniotic fluid at term has clinical implications. The first report by Banks and Miller noted that women who had a borderline AFI, i.e., their amniotic fluid index fell within the intermediate range between "normal" and

"oligohydramnios", had significantly worse outcomes during pregnancy compared to those whose AFI was normal [7]. Later studies involving cohorts retrospectively analysed data collected from pregnant women in whom oligohydramnios was identified and found similarly high rates of various poor outcomes such as growth restriction of the fetus, caesarean delivery due to abnormal fetal heart rate tracings, and lower percentiles for birth weight [8,9]. However, other researchers failed to replicate these findings; they reported perinatal outcomes very similar to those of normal amniotic fluid levels, except there were slightly higher percentages of induced labour in cases where oligohydramnios was present [10].

It appears that some of the differing conclusions may be based on differences in research design, in what are considered acceptable values of the amniotic fluid index for borderline oligohydramnios, and in which week of gestation was measured. Although there is considerable evidence which supports conflicting views about the perinatal implications of borderline oligohydramnios in pregnancies at term, there remains very little evidence-based information regarding the extent to which borderline oligohydramnios should prompt intensified antenatal surveillance and/or an earlier delivery. Additionally, much of the existing evidence has originated from studies conducted within populations and obstetric environments which are different from those found in our institution; as a result, we have been unable to identify sufficient local data which address this issue. In order to investigate potential differences in adverse perinatal outcomes in pregnancies complicated by borderline oligohydramnios compared with those complicated by overt oligohydramnios and normal amniotic fluid volumes, we conducted a retrospective observational study comparing the rate of adverse perinatal outcomes among pregnancies complicated by borderline oligohydramnios, overt oligohydramnios and normal amniotic fluid indices.

Methods

Study Design and Population

A retrospective cohort study was undertaken using the medical records of all singleton births occurring at term (37–42 completed weeks of gestation), from January 2021 to December 2025. In which an amniotic fluid index (AFI) had been recorded at least once in the seven days immediately before birth. Only eligible subjects included those whose singleton birth had an AFI measured within one week of their birth and were categorised into three groups: borderline oligohydramnios (AFI = 5.1–8.0 cm), oligohydramnios (AFI ≤ 5.0 cm). In addition, for every subject with borderline oligohydramnios, a randomly selected subject from the same hospital population with normal AFI values (AFI = 8.1–25.0 cm), and who delivered closest in time to the subject with borderline oligohydramnios, served as a control for that particular subject. Excluded from this analysis were all singleton deliveries where birth occurred < 37 weeks; where there was more than one fetus present; when premature rupture of membranes was diagnosed; when pre-eclampsia developed during pregnancy; when diabetes mellitus developed during pregnancy; when hypertension developed during pregnancy; if a major congenital anomaly of the fetus was identified; or if a mother had severe systemic disease.

Definitions and Data Collection

The date of gestation was determined either by the time of the last menstruation or from an ultrasound that was performed during the first trimester prior to week 14 of gestation. Sonographic determination of AFI was done through the measurement of the greatest fluid pocket vertically within each of the four uterine quadrants. Data regarding maternal and obstetric/neonatal outcomes were collected for both groups, including maternal demographics and pregnancy-related information: maternal age, extremes of maternal age (less than 18 years or greater than 35 years), number of pregnancies (gravidity), number of deliveries (parity), whether this is the mother's first pregnancy (nulliparous), history of previous caesarean section delivery, and fetal gender, together with AFI. Obstetric and neonatal data included labour initiation, mode and reason of delivery, gestational age at delivery, birth weight, meconium-stained amniotic fluid, chorioamnionitis, Apgar score after five minutes, and NICU admission. A small for gestational age (SGA) infant was defined as having a birth weight less than the 10th percentile for gestational age as per established population-based birth weight standards [11].

Outcomes

The major outcomes were whether or not an infant was small-for-gestational-age (SGA) at birth and/or if she had a caesarean section because of fetal distress. A composite adverse neonatal outcome was pre-specified as occurring when at least one of the following events occurred: caesarean section for fetal distress, meconium-stained amniotic fluid, low Apgar scores (< 7 at 5 minutes post-delivery) or hospitalisation in the Neonatal Intensive Care Unit (NICU). We included only those caesarean sections that were performed specifically for fetal distress, so we could measure what happened to the newborn versus what happened to her mother.

Sample Size

We calculated our total sample size based on the prior study demonstrating a statistically significant higher prevalence of infants born small-for-gestational-age among those whose mothers had borderline amniotic fluid index compared to those who had normal amniotic fluid index [8]. Using a two-tailed test, alpha = 0.05 and beta = 0.20 (power = 80%), we needed a minimum of 112 women per comparison group. As there were significantly more women meeting our eligibility criteria than the minimum sample size we estimated during the course of our study, we had sufficient participants to complete our research design.

Statistical Analysis

The continuous data were presented as mean $\pm$ SD or median (IQR) in order to compare them by using the independent samples t-test or the Mann-Whitney U test appropriately. The Categorical data were presented as frequency (%) and were compared using a χ^2 test or Fisher's exact test if one or both cells have an expected count <5 . To find out if there is an association between borderline oligohydramnios and SGA babies, multivariate logistic regression analysis was performed, while controlling for maternal age and nulliparity. Likewise, it has also analysed whether borderline oligohydramnios is associated with a caesarean section due to a distressed fetus, while controlling for maternal age, nulliparity, SGA status, and induction of labour. In addition, the results are provided in terms of the adjusted odds ratio (aOR) with 95% CI. P-value ≤ 0.05 (two-tailed) is considered statistically significant. All statistical analyses have been performed on IBM SPSS Statistics for Windows version 30 (Armonk, New York, USA) [12].

Results

Of these, 622 pregnancies met the eligibility criteria, which included 142 women with borderline oligohydramnios, 338 women with oligohydramnios and 142 women with a normal AFI who were individually matched to the borderline group. The baseline demographic and obstetric factors for each of the three groups are shown in Table 1. Maternal ages were the same for all three study groups ($p = 0.808$); however, there were higher percentages of extreme maternal ages in the oligohydramnios study group compared with the two other study groups (oligohydramnios: 11.5% vs borderline oligohydramnios: 6.3% vs control: 3.5%; $p = 0.009$). There were also higher frequencies of nulliparous women within both the borderline oligohydramnios (54.9%) and oligohydramnios (46.4%) study groups compared with those in the control group (control: 26.8%; $p < 0.001$). The difference in medians of AFI among the study groups ($p < 0.001$) was consistent with the definitions of the study groups, while the incidence of prior caesarean deliveries and male fetuses did not differ between the study groups.

Table 1. Baseline maternal and pregnancy characteristics of the study groups.

Variable	Borderline oligohydramnios (AFI 5.1–8.0 cm) N = 142	Oligohydramnios (AFI ≤ 5.0 cm) N = 338	Normal AFI (8.1–25 cm) N = 142	p value
Maternal age, years, mean $\pm$ SD	28.9 $\pm$ 4.6	29.2 $\pm$ 5.2	29.1 $\pm$ 3.0	0.808
Maternal age <18 or >35 years, n (%)	9 (6.3)	39 (11.5)	5 (3.5)	0.009
Gravidity, median (IQR)	2 (1–3)	2 (1–3)	3 (2–3)	<0.001
Parity, median (IQR)	0 (0–2)	1 (0–2)	1 (0–2)	<0.001
Nulliparity, n (%)	78 (54.9)	157 (46.4)	38 (26.8)	<0.001
Previous caesarean delivery, n (%)	11 (7.7)	34 (10.1)	18 (12.7)	0.387
Male fetus, n (%)	76 (53.5)	160 (47.3)	72 (50.7)	0.442
AFI, cm, median (IQR)	5.9 (5.3–6.3)	3.7 (3.2–4.3)	13.9 (11.5–16.4)	<0.001

AFI, amniotic fluid index; SD, standard deviation; IQR, interquartile range. Bold p values denote statistical significance ($p < 0.05$).

The obstetric and neonatal data are shown in Table 2. The percentage of deliveries induced for labour was greater in both the borderline oligohydramnios (79.6%) and oligohydramnios (68.3%) groups when compared with the control group (43.0%; $p < 0.001$). The average birth weights in the borderline (3120 $\pm$ 472 g) and oligohydramnios (3150 $\pm$ 416 g) groups were less than those in controls (3300 $\pm$ 452 g; $p < 0.001$). In addition, there was a slight difference in the gestational age of delivery between the three groups ($p < 0.001$). There was no statistical difference in the rate of small-for-gestational-age (SGA) neonates between the borderline (11.3%) and oligohydramnios (11.2%) groups. However, this rate was significantly greater than in the control group (3.5%; $p = 0.022$).

Likewise, there was a significant increase in the number of caesarean deliveries due to fetal distress in the borderline (16.2%) and oligohydramnios (13.0%) groups as compared to controls (4.9%; $p = 0.009$). Finally, the incidence of a composite adverse neonatal outcome (caesarean delivery for fetal distress, meconium-stained amniotic fluid, a five-minute Apgar score <7 , or NICU admission) was greater in both the borderline (31.7%) and oligohydramnios (26.9%) groups when compared to controls (16.9%; $p = 0.013$) (Fig. 1).

In multivariable logistic regression that included only cases in the borderline oligohydramnios group and controls, being in the borderline oligohydramnios group was found to be independently predictive of having a small for gestational age (SGA) neonate as compared to controls when adjusted for both maternal age and parity as a nonparous woman (adjusted odds ratio [aOR] 3.92, 95% confidence interval [CI] 1.35–11.38; $p = 0.012$). Similarly, after adjusting for maternal age, parity as a nonparous woman, whether or not the newborn is SGA, and if labour was induced, being in the borderline oligohydramnios group was also found to be independently predictive of needing to have a caesarean delivery due to fetal distress (aOR 3.55, 95% CI 1.34–9.42; $p = 0.011$).

Table 2. Obstetric and neonatal outcomes of the study groups.

Variable	Borderline oligohydramnios N = 142	Oligohydramnios N = 338	Normal AFI N = 142	p value
Labour induction, n (%)	113 (79.6)	231 (68.3)	61 (43.0)	<0.001
Gestational age at delivery, wk, mean $\pm$ SD	39.6 $\pm$ 1.2	39.4 $\pm$ 1.0	39.9 $\pm$ 1.2	<0.001
Birthweight, g, mean $\pm$ SD	3120 $\pm$ 472	3150 $\pm$ 416	3300 $\pm$ 452	<0.001
SGA neonate, n (%)	16 (11.3)	38 (11.2)	5 (3.5)	0.022
Meconium-stained amniotic fluid, n (%)	9 (6.3)	27 (8.0)	5 (3.5)	0.196
Chorioamnionitis, n (%)	5 (3.5)	13 (3.8)	3 (2.1)	0.627
Caesarean delivery (any), n (%)	36 (25.4)	76 (22.5)	24 (16.9)	0.209
Caesarean delivery for fetal distress, n (%)	23 (16.2)	44 (13.0)	7 (4.9)	0.009
5-min Apgar score, median (IQR)	10 (10–10)	10 (10–10)	10 (10–10)	0.932
5-min Apgar score <7, n (%)	0 (0.0)	0 (0.0)	1 (0.7)	1.000
NICU admission, n (%)	15 (10.6)	31 (9.2)	11 (7.7)	0.713
Composite adverse neonatal outcome, n (%)	45 (31.7)	91 (26.9)	24 (16.9)	0.013

SGA, small-for-gestational-age; IQR, interquartile range; NICU, neonatal intensive care unit. The composite adverse neonatal outcome was defined as at least one of: caesarean delivery for fetal distress, meconium-stained amniotic fluid, a five-minute Apgar score <7, or NICU admission. Bold p values denote statistical significance ($p < 0.05$).

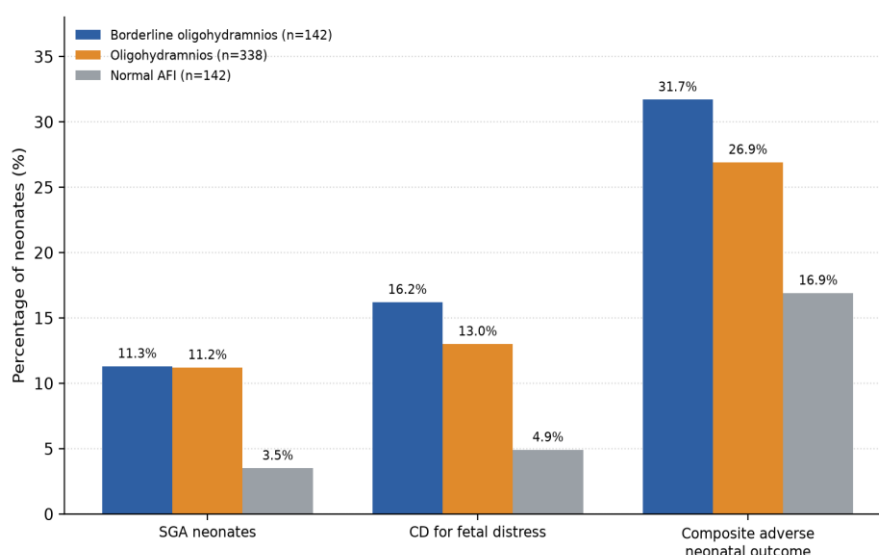


Fig. 1. Selected adverse neonatal outcomes according to amniotic fluid category. SGA, small-for-gestational-age; CD, caesarean delivery; AFI, amniotic fluid index.

Discussion

In this matched cohort of term pregnancies, borderline oligohydramnios was associated with a statistically significant increase in the number of small-for-gestational-age (SGA) neonates and with the frequency of caesarean deliveries due to fetal distress compared to pregnancies with a normal amniotic fluid index (AFI). Both of these relationships remained significant when controlling for potential confounding variables. The composite adverse neonatal outcome was also found to occur more frequently in pregnancies with decreased amniotic fluid. Interestingly, while the relative risks were similar to the ones seen with overt oligohydramnios for borderline oligohydramnios, there were no differences in frequency for several other outcomes, including meconium-stained amniotic fluid, chorioamnionitis, overall caesarean delivery rate, or neonatal intensive care unit admissions. Overall, our data support the position that a borderline decrease in amniotic fluid at term pregnancy is not necessarily a benign finding. Our results concur with previously reported data from Sgayer et al., who were among the first to demonstrate that borderline oligohydramnios can result in an increased frequency of SGA neonates and caesarean delivery for fetal distress in term pregnancies [13]. The Sgayer et al. study showed a strong association between borderline amniotic fluid and significantly elevated adjusted ORs for SGA neonates and caesarean delivery for fetal distress. Specifically, the adjusted ORs were 3.6 (95% CI = 1.1–11.6) for SGA neonates and 3.0 (95% CI = 1.1–8.3) for caesarean delivery for fetal distress. These OR values are strikingly consistent with the adjusted ORs of 3.92 (95% CI = 1.35–11.38) and 3.55 (95% CI = 1.34–9.42), which we calculated based on our own study's data. A subsequent systematic review and meta-analysis further concluded that borderline amniotic fluid levels are associated with adverse perinatal outcomes, lending additional weight to the notion that this intermediate category is clinically meaningful [14]. These observations can be explained by a larger body of research which supports the connection between low levels of amniotic fluid and poor fetal development and intrapartum complications.

Oligohydramnios has been shown through systematic reviews and meta-analyses to significantly elevate the risk of both small-for-gestational-age (SGA) infants and caesarean deliveries due to fetal distress in what would otherwise be normal pregnancies [15]. Cohort studies using comparable amniotic fluid thresholds to determine whether borderline AFI were related to adverse perinatal outcomes also demonstrated an association between AFI and perinatal outcome [9]. Combining these results with the widely held understanding that the quantity of amniotic fluid may indirectly indicate the health of the fetus [2] supports the biological plausibility of our findings regarding the association between reduced amniotic fluid and impaired fetal growth. The relationship between reduced amniotic fluid and impaired fetal growth appears most relevant when looking at cases of oligohydramnios in isolation. The relationship between isolated oligohydramnios in both term and post-term and an elevated rate of SGA infants and caesareans for fetal distress was documented through a systematic review with meta-analysis; however, there was no noted elevation in neonatal acidemia [16]. Similar results were found in more contemporary studies utilising the single deepest pocket methodology, where it was found that isolated oligohydramnios increases the probability of being born with a weight less than the tenth percentile [17]. Therefore, our study extends previous studies showing that the relationship between oligohydramnios and impaired growth is present before reaching the conventionally accepted level for defining oligohydramnios.

Although there is agreement among investigators regarding the potential impact of decreased amniotic fluid volume on fetal development, there are inconsistencies within their conclusions. The association of a borderline AFI with an elevated incidence of small-for-gestational-age (SGA) newborns highlights the growth-related effects of even moderate reductions in fluid volume, whereas other outcomes have been less frequently impacted by variations in fluid volume [18]. An investigation recently suggested that the degree of reduction in amniotic fluid volume has little or no effect on maternal/infant perinatal risks, although it did suggest that minor degrees of amniotic fluid loss result in additional infant/perinatal risks (adjusted odds ratio = 1.96; 95% confidence interval = 1.09–3.78) [19]. This ambiguity illustrates one of the challenges involved in identifying a specific amniotic fluid volume below which clinical action would be warranted. The variability in estimates of amniotic fluid volumes among investigations could also contribute to differences in results. A meta-analysis of randomised controlled trials investigating the use of the AFI versus single deepest vertical pocket in identifying pregnancies with oligohydramnios determined that AFI identified significantly more cases of oligohydramnios and prompted significantly more obstetric interventions; however, neither measure improved perinatal outcomes [20]. The multicenter SAFE trial similarly reported that the AFI provided no advantage over the single deepest pocket in predicting adverse pregnancy outcome [4].

Consequently, because this study used the AFI to classify levels of amniotic fluid, some pregnancies which were identified as having lower than average amniotic fluid (borderline) may not have been categorised that way if they had been evaluated based upon the single deepest pocket. As such, the interpretations of the data presented here may need to take into account these distinctions in order to understand their applicability. The potential for borderline oligohydramnios to lead to poor fetal growth is significant because there has been a long-established link between fetal growth restriction (FGR) and adverse outcomes at birth [21]. Based on this, current guidelines recommend delivering babies whose mothers have had pregnancies complicated by isolated oligohydramnios in the late preterm to early term gestations [5], but how these recommendations apply to women with borderline amniotic fluid levels remains unclear. Our study shows that women with borderline amniotic fluid volumes are likely better served through increased fetal surveillance, although prospective trials will be needed to identify the best approach to manage this condition. The research has several positive factors. We could look at the perinatal consequences of borderline oligohydramnios in relatively pure form because this research confined the cohort to term births and excluded most important maternal and fetal co-morbidity conditions [1].

Measured confounding variables were also lessened through both a one-to-one control match by proximity of delivery and multi-variable adjustments. However, the research also has several negative aspects. The one-centre, retrospective nature of the study makes it vulnerable to both selectivity and information biases. Although the size of babies was evaluated using an outside population-based on birth weight standards [11], that does not mean they are as reflective of our own population. Fluid volume was estimated with an AFI instead of evaluating the single deepest pocket. The composite outcome is made up of four individual outcomes (a caesarean delivery for fetal distress; meconium-stained amniotic fluid; an Apgar score < 7 at five minutes after birth; and NICU admission) without including umbilical artery pH or Doppler indices, when those values were not uniformly recorded. Furthermore, the small number of adverse events allowed us to have wide CIs around many of these estimates, so we should be careful about how we interpret the results.

Conclusion

These data collectively suggest that at term, borderline oligohydramnios is associated with a greater likelihood than normal amniotic volume of having an SGA neonate; additionally, there was a similar increase in likelihood of undergoing a caesarean section due to fetal distress. The data do not support treating borderline oligohydramnios simply as an 'incident' but provide evidence supporting closer monitoring of fetuses with such volumes. Future prospective studies should be designed to determine how best to monitor and when to deliver the fetus in cases where borderline amniotic volumes have been detected.

Conflicts of Interest

The authors declare no conflicts of interest.

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