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NARRATIVE REVIEW

Evaluating the effectiveness of castor oil for labour induction: a narrative review

Effectiveness of castor oil for induction

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ABSTRACT

Background/Objectives. The process of artificially stimulating the uterus to initiate labor is commonly referred to as labor induction. This procedure should be offered to women only when supported by scientific evidence demonstrating that the benefits of initiating labor early outweigh the associated risks. These risks include complications related to prematurity or post-term pregnancy. Various methods for inducing labor are available, categorized into pharmacological and mechanical approaches. Among pharmacological methods, the administration of exogenous prostaglandins such as Dinoprostone and misoprostol is the most widely used. Mechanical methods include transcervical catheters, amniotomy, and membrane sweeping. Additionally, international guidelines mention several “non-traditional” methods, such as acupuncture, herbal remedies, homeopathy, hot baths, enemas, sexual activity, and castor oil. The objective of this review is to evaluate the effectiveness of castor oil as a method for inducing labor.

Methods. A bibliographic search was conducted using three biomedical databases: PubMed, Embase, and CINAHL. The research question was formulated using the PIO (Population, Intervention, Outcome) framework.

Results. The most recent clinical guidelines advise against the routine use of castor oil for labor induction. However, some studies have reported its effectiveness as a non-traditional method for initiating labor.

Conclusions. Given the demonstrated effectiveness of castor oil in stimulating uterine contractions, its low cost, and the lack of significant side effects associated with its use, this method remains an area of interest for further research.

Key words

Pregnancy; pregnant women; castor oil; induction labor.

Introduction

The procedure of artificially stimulating the uterus to induce labor is commonly referred as induction of labor (IOL) [1]. This technique aims to stimulate uterine contractions before the start of spontaneous labor and is indicated when the maternal and perinatal risks of continuing pregnancy outweigh those associated with expedited birth [2]. IOL is frequently used in birth centres worldwide. Its use must be clinically justified and carefully evaluated since the risks of IOL itself [3]. The indications for IOL can be categorized into high-priority indications (chorioamnionitis, preeclampsia, post-term pregnancy, significant maternal illness, antepartum haemorrhage, fetal compromise, rupture of membranes) and other indications [4].

The frequency of IOL has increased in recent decades. In developed countries, 20 to 25 % of women undergo IOL annually [5]. In Italy, the latest national data available indicates a percentage of induced births at 31.5% [6].

Before the starts of any labor's changes, the uterine cervix is approximately three and a half centimetres long. It is mainly composed of collagen and 10-15% of smooth muscle. Numerous changes must occur to initiate labor and allow dilatation of the cervical canal [7]. A wide range of methods is available for labor induction, each with different mechanisms of action, side effects, costs, duration, need for continuous maternal-fetal monitoring, and varying resource usage. The choice of one method over another depends on the indication for induction, guidelines and protocols, urgency to achieve delivery, clinical factors, and the preferences of both the woman and the healthcare provider [8].

Induction methods are divided into pharmacological and mechanical: among the pharmacological methods, prostaglandins are commonly used as they induce rapid cervical dilatation; however, they require hospital admission and continuous monitoring of side effects, especially fetal tachycardia [5]. The use of prostaglandins is recommended for inducing labor in women with an unfavourable cervix (Bishop score <6). Several Cochrane reviews [7,8] have demonstrated the effectiveness of PGE₂ in its various formulations compared to placebo, particularly in achieving delivery within 24 hours [9, [10]. Synthetic oxytocin is also widely used, despite possible negative effects such as increased infection risk for the mother and baby, abnormal uterine contractions, higher incidence of instrumental delivery, uterine hyperstimulation, and lower maternal satisfaction with the birth experience [11]. Among the traditional methods, the use of oral misoprostol, a synthetic analogue of prostaglandin E₁, has also proven effective in inducing labor [12] [13]. Initially used for the prevention and treatment of gastric ulcers and generally to prevent damage to the gastrointestinal

mucosa, misoprostol is an inexpensive drug, stable at room temperature, and available in many countries worldwide, making it particularly useful in resource-poor settings [14]. For this reason, the World Health Organization has included misoprostol in the list of essential medicines [15]. Misoprostol acts on the cervix, facilitating cervical dilation and simultaneously promoting uterine contractions [16]. There is an extensive bibliography demonstrating the efficacy and superiority of misoprostol compared to other PGE₂-based drugs. Specifically, misoprostol shows greater effectiveness in reducing the time between induction and delivery, increasing the likelihood of achieving vaginal delivery within 24 hours, ensuring greater safety in the case of premature rupture of membranes, and reducing the risk of caesarean section [17]. On the other hand, Dinoprostone is a synthetic preparation chemically and structurally identical to prostaglandin E₂ (PGE₂), which is naturally present in maternal tissues, particularly in the placenta, uterus, amniochorion membranes, and cervix. Its primary local effects include changes in cervical consistency, dilation, and effacement, as well as indirectly inducing uterine contractile activity by stimulating the myometrial response to endogenous or exogenous oxytocin [18].

Regarding mechanical methods, including the use of transcervical catheters, amniotomy, and membrane sweeping, numerous studies [19], [20] in recent years have demonstrated their efficacy and safety for pre-induction of labor in the case of an unfavourable obstetric finding. Mechanical methods are believed to work by stimulating the endogenous production of prostaglandins through the stretching of amniochorion membranes and myometrial cells, and by promoting the production of endogenous oxytocin via the Ferguson reflex. Current literature data [21], [22] have highlighted a comparable rate of caesarean sections to the use of prostaglandins (PGE₂), similar efficacy to prostaglandins, a reduced risk of uterine hyperstimulation with fetal heart rate alterations compared to prostaglandins, a reduced risk of caesarean sections compared to the use of oxytocin, and a good safety profile in women with previous caesarean sections.

Additionally, it should be noted that mechanical methods are all low-cost. Among mechanical methods, the most widely used is the balloon catheter. The advantages of using the balloon catheter are the possibility of employing it in an outpatient setting, which results in a reduction in hospital stay and a decrease in the caesarean delivery rate [5]. Additionally, it does not require continuous monitoring and reduces the risk of uterine hyperstimulation [5].

International guidelines also mention a series of "non-traditional" methods such as acupuncture, herbs, homeopathy, hot baths, enemas, sexual activity, and castor oil. Recent indications report that the available evidence does not support the use of these methods for labor induction [8].

Given these premises, the aim of this study is to provide a response regarding the effectiveness of using castor oil as a method for inducing labor.

Materials and Methods

For the bibliographic search, three biomedical databases—PubMed, Embase, and CINAHL—were consulted. No time restrictions were applied to ensure the search strategy was as inclusive as possible and aligned with the study's objectives. The research question was developed using the PIO framework, defined as follows:

- **P (Population):** Pregnant women requiring labor induction for obstetric reasons.
- **I (Intervention):** Use of castor oil.
- **O (Outcome):** Induction and initiation of labor.

Only articles in English, including case report were included in the review. No restrictions were applied regarding the population's age, gestational age at induction, the presence of obstetric

pathologies, or any specific obstetric conditions. Regarding the intervention, all methods of castor oil administration were considered, including variations in dosage and timing. The application of the PIO framework facilitated evidence synthesis and contributed to the development of this narrative review. SANRA guidelines have been followed for the preparation of the review [23]. Due to the topic of the review, a narrative review has been performed summarizing the findings.

Results

The correlation between castor oil and induction

Castor oil, also known as *Oleum Palmae Christi*, is obtained from the seeds of *Ricinus communis* and has been used for centuries for its therapeutic purposes. It was first described in the Ebers Papyrus of ancient Egypt over 3,500 years ago [24]. It is a triglyceride characterized by a high content of a hydroxylated unsaturated fatty acid, the Ricinoleic acid. After the oral ingestion of castor oil, the Ricinoleic acid is released by lipases in the intestinal lumen and then absorbed, inducing a strong laxative effect [25]. The United States Food and Drug Administration classifies castor oil as a laxative, but several studies suggest its effectiveness in inducing labor [26].

Prostaglandin E2 levels in the portal vein seem to increase after the use of castor oil. Furthermore, prostaglandin E2 receptors are targets of Ricinoleic acid. The prostaglandin EP3 receptor is responsible for mediating the effects of castor oil. In fact, pharmacological and molecular biology studies have shown the presence of prostaglandin EP3 receptors in the pregnant uterus. Their activation can induce the contraction of the smooth muscle of the uterus. This molecular and physiological mechanisms explain the correlation between castor oil and labor [17, 7, 9].

The most recent guidelines indicate that labor induction with castor oil is not recommended, as the evidence does not support this method [8], [27], [28]. Nevertheless, in many centres, this “non-traditional” method of induction is routinely used. A survey among members of the American College of Nurse-Midwives revealed that 90 out of 172 midwives interviewed had used natural supplements for labor stimulation, and 93% of those who used natural methods had used castor oil (14). In the context of out-of-hospital midwifery in the United States, castor oil is the most used method of induction in nulliparous women and the second most popular method, after membrane stripping, among multiparous women (24). The use of castor oil as a method of labor induction was evaluated by Cochrane in 2013 with respect to a series of birth-related outcomes. The results are limited because the number of participants in the studies examined was too small to draw significant conclusions. The only result highlighted by the review is that castor oil induces nausea. In any case, the effectiveness of castor oil in inducing labor was not investigated [10].

Castor Oil: Induction of Labor and other Obstetric and Neonatal Outcomes

The living literature on the use of castor oil for labor induction is not extensive. The data collected from a sample of 1,653 patients indicate that the intake of castor oil increases the prevalence of vaginal births compared to the control group. Furthermore, the effectiveness of labor induction is significantly higher in the castor oil group than in the control group [29]. Administering a non-pharmacological intervention through a of castor oil promotes cervical maturation and the onset of labor [30], [31].

Regarding the association between castor oil use and the presence of meconium-stained amniotic fluid, the results are controversial. Some studies report an association between the intake of the substance and meconium-stained fluid [32] (Sahara et al., 2014), while others find no correlation in the groups studied [33], [34]. A 2022 review [35], which included 12 studies, reported data on the association between castor oil use and the presence of meconium-stained amniotic fluid in 6 of the studies. All six authors reported that there were no differences in the presence of meconium-stained amniotic fluid between the castor oil group and the control group. This information is

relevant for understanding the effects of castor oil on pregnancy and childbirth, as meconium in the amniotic fluid can indicate fetal stress.

The duration of labor, including the first, second and third stage, and its total duration, seems to be shorter in the castor oil group compared to the control group [32]. However, no differences are observed concerning the outcome of "prolonged labor" when comparing castor oil to no treatment [33]. Data on the APGAR score are also conflicting. At the first minute, patients who took castor oil appear to obtain lower scores for their neonates, compared to the group without the intake of the substance [32]. However, other studies do not detect any differences between the groups examined [33], [34], [31]. Recent data from a review, indicate that there are no significant differences in the Apgar scores between the group that took castor oil and the control group [35].

The percentage of caesarean sections also seems to decrease among patients who took castor oil compared to the control group [35] and the use of castor oil does not increase the risk of caesarean section [31].

The correlation between the presence of nausea after taking castor oil has already been discussed and clarified by Cochrane [36] and other study [34], [37].

Discussion and implications for practice

Castor oil is considered one of the so-called non-traditional methods for labor induction. It is a very ancient molecule and has been used for a long time. This concept is reinforced by literature [38], which has demonstrated that this method plays a role in increasing the rate of vaginal delivery compared to those who receive no treatment, with a high safety profile and a very low rate of adverse effects following its administration. In general, based on current literature data, it seems reasonable to consider the use of castor oil for labor induction in women with low-risk pregnancies, especially given the high rate of side effects associated with oxytocin [39], [34]. Furthermore, castor oil is a resource that can be considered among the methods for labor induction, especially in resource-poor countries where access to healthcare services is often very difficult, due to its low cost and ease of procurement. The action of castor oil targets the receptors for prostaglandin E₂, with Ricinoleic acid acting on these receptors. The EP₃ receptor specifically mediates the effects of castor oil on the intestinal and uterine muscles [35]. The understanding of this mechanism of action underlies the results of other studies [40], which highlight the high rate of vaginal delivery after castor oil administration compared to control groups. Regarding the adverse effects of castor oil, the only ones described in some studies [40], [41], [29] were nausea and diarrhoea, which were never found to be debilitating for the women who took the preparation.

There are many guidelines [8], [27], [28], in the topic of labor induction available today, and in the most recent international recommendations and guidelines, the use of non-traditional induction methods, including castor oil, is not indicated. As already emphasized by a previous study, it would be useful to develop guidelines for the use of herbal medicines, particularly castor oil, in pregnant women [29]. However, considering the literature available to date, we can conclude that castor oil can still be considered, especially in countries where access to healthcare resources is difficult for most people and in low-risk pregnancies. The role of the midwife in this context is crucial, and it is therefore important for midwives to collaborate effectively with obstetricians and discuss the use of castor oil as a safe method to promote cervical dilation and prevent undue caesarean surgery [30], [42-44].

Conclusions

In this review we analysed the state of the art on castor oil, and, more generally, on the mechanisms available for the induction of labor. Castor oil, which falls under non-traditional methods for labor induction, is not recommended by major national and international guidelines. However, considering its action on the uterine muscles, its low cost, and the absence of important side effects from its administration, it is still a method that is worth to be investigated.

However, the poor methodological quality, the limited number of studies, and the heterogeneity among studies prevent a definitive assessment of the effectiveness of this method for labor induction. It's worthily to note and acknowledge among the limitation of the present review that the heterogeneity in control group selection in the cited studies, underscores the need for future studies with standardized comparison groups to provide a clearer understanding of the role of castor oil in labor induction. Future studies will help clarify which interventions are most effective and which patient populations may benefit from this approach.

Major obstetric organizations have not endorsed castor oil for labor induction. For example, the American College of Obstetricians and Gynecologists (ACOG) and the UK's National Institute for Health and Care Excellence (NICE) explicitly advise against using castor oil to induce labor, given the lack of robust evidence of benefit. These bodies prioritize induction methods with well-documented efficacy and safety profiles, a standard that castor oil does not currently meet. The above-analysed studies on castor oil are few and methodologically limited, yielding inconsistent findings. As discussed, side effects are a key concern – castor oil's cathartic action commonly causes gastrointestinal distress (nausea, vomiting, and diarrhea). Moreover, there is apprehension about potential fetal effects; some reports observed a higher incidence of meconium-stained amniotic fluid after castor oil use, which raises concern for neonatal meconium aspiration and related complications. Considering these issues – insufficient high-quality evidence and possible risks – professional guidelines have concluded that castor oil should not be routinely used for induction

In conclusion – High-quality evidence supporting castor oil for labor induction remains insufficient. Both ACOG and NICE emphasize that further research is needed before castor oil could be considered an evidence-based option. Any future studies would require rigorous design and larger sample sizes to conclusively determine efficacy and safety. Until such data are available, there is consensus that clinicians and patients should adhere to established medical guidelines for induction, utilizing methods with proven safety and effectiveness.

COMPLIANCE WITH ETHICAL STANDARDS

Authors' contribution

A. Me, A.M.: Conceptualization. A. Me, A.M.: Writing – original draft. V.R., E.D., L.L., C.V.: Writing – review & editing. P. M., A. L., B. M. reviewed and revised the manuscript.

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Study registration

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Disclosure of interests

The authors declare that they have no conflict of interests.

Ethical approval

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References

- [1] Aishwarya R, Divya S, Shivaranjani K.S, Sharanya NMR. Comprehensive Systematic review of pharmacological interventions for labor induction: mechanism, efficacy and safety. *Int J Acad Med Pharm* 2023;5:749-754. <https://doi.org/10.47009/jamp.2023.5.5.147>.
- [2] Hong J, Atkinson J, Roddy Mitchell A, Tong S, Walker SP, Middleton A, et al. Comparison of Maternal Labor-Related Complications and Neonatal Outcomes Following Elective Induction of Labor at 39 Weeks of Gestation vs Expectant Management. *JAMA Netw Open* 2023; 6(5):e2313162.. <https://doi.org/10.1001/jamanetworkopen.2023.13162>.
- [3] WHO Guidelines Review Committee. WHO recommendations on induction of labour, at or beyond term. 2018. Available at: <https://www.who.int/publications/i/item/9789240052796>. Accessed on August 2024.
- [4] Robinson D, Campbell K, Hobson SR, MacDonald WK, Sawchuck D, Wagner B. Guideline No. 432a: Cervical Ripening and Induction of Labour – General Information. *J Obstet Gynaecol Canada* 2023; 45(1):35-44.e1. <https://doi.org/10.1016/j.jogc.2022.11.005>.
- [5] Abdelhakim AM, Shareef MA, AlAmodi AA, Aboshama RA, Fathi M, Abbas AM. Outpatient versus inpatient balloon catheter insertion for labor induction: A systematic review and meta-analysis of randomized controlled trials. *J Gynecol Obstet Hum Reprod* 2020; 49(8):101823. <https://doi.org/10.1016/j.jogoh.2020.101823>.
- [6] Boldrini R, Di Cesare M, Basili F, Campo G, Moroni RM, Rizzuto E. Certificato di assistenza al parto (CeDAP) Analisi dell'evento nascita 2021. Available at: www.salute.gov.it/statistiche. Accessed on August 2024.
- [7] McCarthy FP, Kenny LC. Induction of labour. *Obstet Gynaecol Reprod Med* 2014;24, 1:9–15. <https://doi.org/10.1016/j.ogrm.2013.11.004>.
- [8] NICE National institute for health and care excellence. Inducing labour. Guidel (Ng207) 2021:1–41. Available at: <https://www.nice.org.uk/guidance/ng207/resources/inducing-labour-pdf-66143719773637>. Accessed August 2024.
- [9] Kelly AJ, Kavanagh J, Thomas J. Vaginal prostaglandin (PGE2 and PGF2a) for induction of labour at term. *Cochrane Database Syst Rev* 2003; (4):CD003101. <https://doi.org/10.1002/14651858.CD003101>.
- [10] Thomas J, Fairclough A, Kavanagh J, Kelly AJ. Vaginal prostaglandin (PGE2 and PGF2a) for induction of labour at term. *Cochrane Database Syst Rev* 2014;(6): CD003101. <https://doi.org/10.1002/14651858.CD003101.pub3>.
- [11] Romano AM, Lothian JA. Promoting, Protecting, and Supporting Normal Birth: A Look at the Evidence. *J Obstet Gynecol Neonatal Nurs* 2008; 37(1):94-104. <https://doi.org/10.1111/j.1552-6909.2007.00210.x>.
- [12] Rahimi M, Haghghi L, Baradaran HR, Azami M, Larijani SS, Kazemzadeh P, et al. Comparison of the effect of oral and vaginal misoprostol on labor induction: updating a systematic

review and meta-analysis of interventional studies. *Eur J Med Res* 2023; 28(1):51. <https://doi.org/10.1186/s40001-023-01007-8>.

[13] Kumar N, Haas DM, Weeks AD. Misoprostol for labour induction. *Best Pract Res Clin Obstet Gynaecol* 2021;77:53–63. <https://doi.org/10.1016/j.bpobgyn.2021.09.003>.

[14] Tang J, Kapp N, Dragoman M, De Souza JP. WHO recommendations for misoprostol use for obstetric and gynecologic indications. *Int J Gynaecol Obstet* 2013; 121(2):186-9. <https://doi.org/10.1016/j.ijgo.2012.12.009>.

[15] WHO. Expert Committee on Selection and Use of Essential Medicines WHO model. Available at: <https://www.who.int/groups/expert-committee-on-selection-and-use-of-essential-medicines>. Accessed August 2024.

[16] Amini M, Reis M, Wide-Swensson D. A Relative Bioavailability Study of Two Misoprostol Formulations Following a Single Oral or Sublingual Administration. *Front Pharmacol* 2020;11:50. <https://doi.org/10.3389/fphar.2020.00050>.

[17] Bolla D, Weissleder SV, Radan A-P, Gasparri ML, Raio L, Müller M, et al. Misoprostol vaginal insert versus misoprostol vaginal tablets for the induction of labour: a cohort study. *BMC Pregnancy Childbirth* 2018; 18(1):149. <https://doi.org/10.1186/s12884-018-1788-z>.

[18] Shirley M. Dinoprostone Vaginal Insert: A Review in Cervical Ripening. *Drugs* 2018; 78(15):1615-1624. <https://doi.org/10.1007/s40265-018-0995-2>.

[19] Leduc D, Biringer A, Lee L, Dy J. Clinical practice obstetrics committee, special contributors. Induction of labour. *J Obstet Gynaecol Can* 2013; 35(9):840-857. [https://doi.org/10.1016/S1701-2163\(15\)30842-2](https://doi.org/10.1016/S1701-2163(15)30842-2).

[20] Cromi A, Ghezzi F, Uccella S, Agosti M, Serati M, Marchitelli G, et al. A randomized trial of preinduction cervical ripening: dinoprostone vaginal insert versus double-balloon catheter. *Am J Obstet Gynecol* 2012; 207(2):125.e1-7. <https://doi.org/10.1016/j.ajog.2012.05.020>.

[21] Jagielska I, Kazdepka-Ziemińska A, Janicki R, Fórmaniak J, Walentowicz-Sadłecka M, Grabiec M. Evaluation of the efficacy and safety of Foley catheter pre-induction of labor. *Ginekol Pol* 2013; 84(3):180-5. <https://doi.org/10.17772/gp/1560>.

[22] Jozwiak M, Bloemenkamp KWM, Kelly AJ, Mol BWJ, Irion O, Bouvain M. Mechanical methods for induction of labour. *Cochrane Database Syst Rev* 2012; (3) CD001233. <https://doi.org/10.1002/14651858.CD001233.pub2>.

[23] Baethge C, Goldbeck-Wood S, Mertens S. SANRA-a scale for the quality assessment of narrative review articles. *Res Integr Peer Rev*. 2019 Mar 26;4:5. doi: 10.1186/s41073-019-0064-8

[24] Franke H, Scholl R, Aigner A. Ricin and *Ricinus communis* in pharmacology and toxicology- from ancient use and “Papyrus Ebers” to modern perspectives and “poisonous plant of the year 2018.” *Naunyn Schmiedebergs Arch Pharmacol* 2019; 392(10):1181-1208. <https://doi.org/10.1007/s00210-019-01691-6>.

[25] Scarpa A, Guerci A. Various uses of the castor oil plant (*Ricinus communis* L.). A review. *J Ethnopharmacol* 1982; 5(2):117-37. [https://doi.org/10.1016/0378-8741\(82\)90038-1](https://doi.org/10.1016/0378-8741(82)90038-1).

[26] DeMaria AL, Sundstrom B, Moxley GE, Banks K, Bishop A, Rathbun L. Castor oil as a natural alternative to labor induction: A retrospective descriptive study. *Women and Birth* 2018; 31(2):e99-e104. <https://doi.org/10.1016/j.wombi.2017.08.001>.

- [27] SIGO, Società italiana di ginecologia e ostetricia. Induzione al travaglio di parto. Available at: https://www.sigo.it/wp-content/uploads/2022/02/LG15_Induzione_Travaglio_Parto.pdf. Accessed August 2024.
- [28] ACOG. The American College of Obstetricians and Gynecologists. Labor Induction. Available at: <https://www.acog.org/womens-health/faqs/labor-induction>. Accessed August 2024.
- [29] Amerizadeh A, Farajzadegan Z, Asgary S. Effect and safety of castor oil on labor induction and prevalence of vaginal delivery: A systematic review and meta-analysis. *Iran J Nurs Midwifery Res* 2022; 27(4):251-259. https://doi.org/10.4103/ijnmr.ijnmr_7_21.
- [30] Moradi M, Niazi A, Mazloumi E, Lopez V. Effect of Castor Oil on Cervical Ripening and Labor Induction: a systematic review and meta-analysis. *J Pharmacopuncture* 2022; 25(2):71-78. <https://doi.org/10.3831/KPI.2022.25.2.71>.
- [31] Mirzaee F, Mirzaee M, Heydari O, Ghazanfarpour M. The effect of using castor oil on the type of delivery, labour induction and neonatal outcomes: a meta-analysis. *Aust J Herb Naturop Med* 2024;36. <https://doi.org/10.33235/ajhnm.36.1.32-40>.
- [32] Abdelgawad SME, University T. Castor Oil Safety and Effectiveness on Labour Induction and Neonatal Outcome. *J Biol Agric Healthc* n.d.;4:1–10. ISSN 2224-3208.
- [33] Gilad R, Hochner H, Savitsky B, Porat S, Hochner-Celnikier D. Castor oil for induction of labor in post-date pregnancies: A randomized controlled trial. *Women Birth* 2018; 31(1):e26-e31. <https://doi.org/10.1016/j.wombi.2017.06.010>.
- [34] Azhari S, Pirdadeh S, Lotfalizadeh M, Shakeri MT. Evaluation of the effect of castor oil on initiating labor in term pregnancy. *Saudi Med J* 2006; 27(7):1011-4. PMID: 16830021
- [35] Amerizadeh A, Farajzadegan Z, Asgary S. Effect and Safety of Castor Oil on Labor Induction and Prevalence of Vaginal Delivery: A Systematic Review and Meta-Analysis. *Iran J Nurs Midwifery Res* 2022; 27(4):251-259. https://doi.org/10.4103/ijnmr.ijnmr_7_21.
- [36] Kelly AJ, Kavanagh J, Thomas J. Castor oil, bath and/or enema for cervical priming and induction of labour. *Cochrane Database Syst Rev* 2013; 2013(7):CD003099. <https://doi.org/10.1002/14651858.CD003099.pub2>.
- [37] Neri I, Dante G, Pignatti L, Salvioli C, Facchinetti F. Castor oil for induction of labour: a retrospective study. *J Matern Fetal Neonatal Med* 2018; 31(16):2105-2108. <https://doi.org/10.1080/14767058.2017.1336223>.
- [38] Zamawe C, King C, Jennings HM, Mandiwa C, Fottrell E. Effectiveness and safety of herbal medicines for induction of labour: a systematic review and meta-analysis. *BMJ Open* 2018; 8(10):e022499. <https://doi.org/10.1136/bmjopen-2018-022499>.
- [39] Garry D, Figueroa R, Guillaume J, Cucco V. Use of castor oil in pregnancies at term. *Altern Ther Health Med* 2000; 6(1):77-9. PMID: 10631825
- [40] Davis L. The use of castor oil to stimulate labor in patients with premature rupture of membranes. *J Nurse Midwifery* 1984; 29(6):366-70. [https://doi.org/10.1016/0091-2182\(84\)90166-6](https://doi.org/10.1016/0091-2182(84)90166-6).
- [41] Azarkish F, Absalan N, Roudbari M, Barahooie F, Mirlashari S BM. Effect of oral castor oil on labor pain in post term pregnancy. *SJKU* 2008; 13 (3) :1-6. Available at: <https://api.semanticscholar.org/CorpusID:70947000>.

[42] Libretti A, Nicosia A, Troia L, Remorgida V. What does the cardiotocography say about SARS-CoV-2 infection? Cardiotocograph monitoring during the pandemic era: a narrative short review. *Italian Journal of Gynaecology and Obstetrics*, 2024, 36(2), pp. 138–145. DOI 10.36129/jog.2024.150

[43] Ferrazzi E.M., Paganelli A., Brembilla G., Healthy Foetuses. Misoprostol Insert Induction HF MIND. A multicentre Italian study on the misoprostol vaginal insert for induction of labour. *Italian Journal of Gynaecology and Obstetrics*, 2021, 33(), pp. 161–169. DOI 10.36129/jog.33.03.04

[44] Libretti A, Troia L, Casarotti C, D'Amato AT, Dallarda G, Ghio M, Nicosia A, Ricci D, Savasta F, Sonzini M, Villa D, De Pedrini A, Surico D, Remorgida V. Pregnancy and neonatal outcomes of SARS-CoV-2 infection discovered at the time of delivery: a tertiary center experience in North Italy. *J Perinat Med*. 2023 Oct 18;52(2):215-221. doi: 10.1515/jpm-2023-0280.

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