

Effect of routine controlled cord traction as part of the active management of the third stage of labour on postpartum haemorrhage: multicentre randomised controlled trial (TRACOR).

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1 **Should routine controlled cord traction be part of the active management of third stage**
2 **of labour? The Tracor multicenter randomized controlled trial**

3

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20

21 **Abstract**

22 **Objectives** Active management of the third stage of labour is recommended for preventing postpartum
23 haemorrhage (PPH). However, the specific effects of each of its components have not been adequately
24 evaluated. The TRACOR Study aimed to assess the impact of controlled cord traction on the incidence
25 of PPH and other characteristics of the third stage of labour, in a high-resource setting.

26 **Design** Randomized controlled trial conducted between January 1, 2010, and January 31, 2011.

27 **Setting** Five French university hospital maternity units

28 **Participants** Women aged ≥ 18 , with a planned vaginal delivery, at a gestational age ≥ 35 weeks, with
29 a singleton fetus.

30 **Interventions** Women were randomly assigned to have third stage of labor managed either by
31 controlled cord traction (CCT), or by standard placenta expulsion (SPE) i.e. awaiting the spontaneous
32 placental separation before facilitating its expulsion. Prophylactic oxytocin just after birth of the baby
33 was administered in the 2 arms.

34 **Main outcome measures** The primary outcome was the incidence of PPH ≥ 500 mL as measured in a
35 collector bag.

36 **Results** The incidence of PPH was not different in the CCT group (9.8% (196/2005) and in the SPE
37 group (10.3% (206/2008), RR 0.95, 95% CI (0.79 to 1.15). The need for manual removal of placenta
38 was significantly less frequent in the CCT than in the SPE group (4.2%(85/2033) and 6.1%(123/2024),
39 RR 0.69, 95%CI (0.53 to 0.90)); as was third stage > 15 minutes (4.5% (91/2030) and 14.3%
40 (289/2020), RR 0.31, 95%CI 0.25 to 0.39)). Women in the CCT group reported a significantly lower
41 intensity of pain and discomfort during the third stage than those in the SPE group. No uterine
42 inversion occurred in either arm.

43 **Conclusions** In a high-resource setting, the use of CCT for the management of placenta expulsion had
44 no significant effect on the incidence of PPH and other markers of postpartum blood loss. Therefore,
45 there is no evidence to recommend routine CCT for the management of placenta expulsion in order to
46 prevent PPH.

47 **Trial registration** ClinicalTrials.gov NCT01044082.

48

49 **“What this paper adds “ box**

50 **What is already known on this subject**

- 51 • Active management of the third stage of labour includes the administration of an uterotonic
52 drug immediately after child birth and controlled cord traction (CCT), and is recommended for
53 the prevention of PPH.
- 54 • The management of third stage of labour without CCT does not increase the risk of severe
55 PPH in low and middle income countries, and therefore could be omitted in non-hospital
56 settings.
- 57 • However, the impact of CCT on PPH incidence and other characteristics of third stage in the
58 context of high-resource settings is unknown.

59 **What this study adds**

- 60 • In a high-resource setting, the use of CCT for the management of placenta expulsion has no
61 significant effect on the incidence of PPH and other markers of postpartum blood loss.
62 Therefore, there is no evidence to recommend routine CCT for the management of placenta
63 expulsion in order to prevent PPH.
- 64 • However, CCT is safe, reduces the length of third stage, the need for manual removal of
65 placenta and for additional uterotonics after placenta delivery, and results in a better
66 experience of the third stage for women.

67

68 INTRODUCTION

69 Postpartum haemorrhage (PPH) remains a major complication of childbirth worldwide. (1)
70 Population-based studies in high-resource countries report a prevalence of severe PPH from 0.5% to
71 1% of deliveries,(2-5) making it the main component of severe maternal morbidity. Uterine atony is
72 the leading cause of PPH, accounting for 60 to 80% of cases(6). Prevention of atonic PPH is thus
73 crucial, and preventive measures are recommended for all women giving birth, given that individual
74 risk factors are poor predictors.

75 Active management of the third stage of labour (AMTSL) has been proposed for the prevention of
76 PPH(7). Its standard definition combines the following three procedures: administration of an oxytocic
77 drug immediately after child birth, early cord clamping and cutting, and controlled cord traction.

78 Several trials(8-11) combined in a meta-analysis(12) showed that AMTSL is associated with a 60%
79 reduction in the incidence of PPH compared with expectant management. Given its efficacy, AMTSL
80 has been included in international(13, 14) and national(15-17) guidelines for the prevention of PPH.

81 However, an adequate evaluation of the specific efficacy of each of its components has not been done.
82 The independent efficacy of preventive oxytocics has been shown with a good level of evidence(18)
83 and it is therefore often considered the essential component of AMTSL. This is not the case for
84 controlled cord traction (CCT).(19) Although most guidelines for prevention of PPH include CCT, its
85 actual implementation is highly variable, varying in Europe from 12% in Hungary to 95% in
86 Ireland.(20) In countries, such as France, where CCT is not recommended, pulling the cord in the
87 absence of any sign of placenta separation is considered poor practice because of the potential risk of
88 uterine inversion.(21)

89 The variation in use of CCT may be explained by the paucity of available evidence for assessing either
90 the efficacy of CCT for the prevention of PPH or its potential risks. Until recently, only two trials
91 conducted in the 1960's (19, 22) and with important limitations had assessed the specific effect of
92 CCT and they had conflicting results. Very recently, a large randomized controlled trial conducted in
93 eight low and middle income countries reported that the omission of CCT as part of AMTSL did not
94 increase the risk of severe PPH(23). The authors concluded that CCT could be omitted in non-hospital

95 settings. However, the results of this trial may be relevant for low/middle income countries and not
96 applicable to other countries.

97 The TRACOR Study aimed to assess the impact of controlled cord traction on the incidence of PPH
98 and other characteristics of the third stage of labour, in a high-resource setting.

99

100 **METHODS**

101 *Trial design*

102 The TRACOR (TRAction of the CORd) trial was a multicenter randomized controlled trial with two
103 parallel groups and took place in five French university hospitals between January 1, 2010, and
104 January 31, 2011.

105 CCT was not a standard part of third-stage management in any of the participating units before the
106 trial. Before the beginning of the trial, all staff likely to recruit women into the trial (midwives and
107 obstetricians) were trained in the trial procedures and more particularly in the technique of CCT. In
108 each participating centre, several training meetings were led by a team from the steering committee
109 pairing a midwife with an obstetrician. Films demonstrated the placement of the collector bag and the
110 practice of CCT. Following this initial training, a period of one month was devoted to using CCT in
111 actual practice. Before the inclusion period, a meeting was organized in each unit to verify the
112 attendants' adherence to the protocol and their ease in practicing the relevant procedures.

113 *Participants*

114 Women aged 18 or more, with a planned vaginal delivery, at a gestational age ≥ 35 weeks, with a
115 singleton foetus, were eligible for inclusion. We excluded women with a severe haemostasis disease,
116 those with placenta praevia, in utero foetal death, and multiple gestations. We also excluded women
117 who did not understand French. Eligible women were approached and offered information about the
118 study during a prenatal visit in the third trimester of pregnancy by a midwife or an obstetrician. This
119 information was repeated after their arrival in delivery room for the planned vaginal delivery; the
120 women then confirmed their participation and provided informed written consent.

121 *Interventions*

122 We compared CCT with standard management of placental expulsion.

123 In the intervention arm, CCT was implemented immediately after the delivery of the baby upon
124 obtaining a uterine contraction, as initially described,(19) according to the following instructions: 1)
125 after birth, CCT is started with a firm uterine contraction without waiting for placenta separation; 2)
126 with one hand, grasp the lower segment between the thumb and index finger and exert steady pressure
127 upwards; 3)at the same time, hold the cord in the other hand, and exert steady cord traction
128 downwards and backwards, exactly countered by the upwards pressure of first hand, so that the
129 position of the uterus remains unchanged. 4) If the placenta is not expelled on the first attempt, repeat
130 CCT with counter-pressure with the next uterine contraction.

131 In the control arm, the attendant awaited the signs of spontaneous placental separation and descent into
132 the lower uterine segment. Once the placenta was separated, it was then delivered through the
133 mother's efforts (helped by fundal pressure or soft tension on the cord to facilitate placental expulsion
134 through the vagina if needed). This standard placental expulsion (SPE) is the usual management in
135 France, as taught in university hospitals and midwifery schools, and it was the routine procedure in the
136 five participating centers before the trial.

137 All other aspects of third stage management were identical in both arms: IV injection of 5 IU oxytocin
138 within 2 minutes after birth; clamping and cutting the cord within the 2 minutes following birth;
139 placement of a graduated collection bag (manufactured by MVF Merivaara France, 100 mL
140 graduation) just after birth, left in place until the birth attendant judged that the postpartum bleeding
141 had stopped and that there was no reason to further monitor it(24), and always at least for 15 minutes;
142 manual removal of the placenta at 30 minutes after birth if not expelled. A blood sample was taken
143 from all women on the second day after delivery for the measurement of haemoglobin (Hb) and
144 haematocrit (Ht).

145 *Outcomes*

146 The primary outcome of the trial was the incidence of PPH defined by blood loss ≥ 500 ml, measured
147 with a graduated collector bag (25). The main secondary outcomes were other objective measures of
148 postpartum bleeding: measured blood loss ≥ 1000 mL at bag removal; mean measured blood loss at 15

149 minutes after birth (the bag had to be left in place at least 15 minutes to have one measure of blood
150 loss at the same time point in all women); mean measured postpartum blood loss at bag removal; mean
151 changes in peripartum haemoglobin and haematocrit (difference between Hb/Ht before delivery and
152 D2). Other secondary outcomes included: supplementary uterotonic treatment, postpartum transfusion
153 (until discharge), arterial embolization or emergency surgery for PPH; other characteristics of the
154 third stage, including its duration, manual removal of the placenta; and women's experience of the
155 third stage, assessed by a self-administered questionnaire on D2 postpartum. Safety outcomes included
156 uterine inversion, cord rupture, and pain.

157 The detail of procedures used to manage the third stage, as well as all clinical outcomes identified
158 during the immediate postpartum, were prospectively collected by the midwife or the obstetrician in
159 charge of the delivery and recorded in the woman's electronic form in the labour room. Other data
160 were collected by a research assistant, independent of the local medical team. An independent Data
161 Monitoring Committee, which met monthly, was responsible for reviewing adherence to the trial
162 procedures, the recruitment and safety data; the quality of collected outcome data was checked in each
163 centre for 10% of the included women, randomly selected, and in all PPH cases.

164 *Sample size*

165 We assumed a 7% incidence of PPH in the absence of CCT. This incidence is that found in the cohort
166 as a whole in the Pithagore6 trial in 6 French perinatal networks in 2006 from a total of approximately
167 147 000 births.(26) We hypothesized that CCT might explain half of the 60% reduction in PPH
168 incidence described in the meta-analysis measuring the overall effect of active management. To show
169 a reduction of at least 30% in the incidence of PPH in the CCT arm -that is, a PPH incidence of 4.9%
170 or less in this arm , with $\alpha = 0.05$, $1-\beta = 0.80$, and a bilateral test, the study required 1990 women with
171 vaginal deliveries in each group, for a total of 3980 patients.

172 Given the expected proportion of women with a caesarean delivery in labour after randomization
173 (estimated at 5% to 10%), a higher number of women needed to be randomized to include the needed
174 number of women with vaginal deliveries. The decision to stop inclusions was made by the

175 independent Data Monitoring Committee, which was able to access the electronic inclusion system to
176 determine the real-time cumulative number of randomized women and their mode of delivery.

177 This sample size provided a 70% statistical power to detect a reduction in the incidence of severe PPH
178 (defined by blood loss ≥ 1000 ml) from 2% to 1% or less of deliveries.

179 *Randomization*

180 Randomization took place after women completed the participation form, during labour and before
181 delivery. It was performed centrally through an automated web-based system, which ensured
182 allocation concealment. Allocation was stratified by centre.

183 *Statistical methods*

184 The two groups were compared for main and secondary outcomes in an intention-to-treat analysis. The
185 effects of CCT were expressed as mean differences with their 95% confidence intervals for
186 quantitative outcomes, and as relative risks with their 95% confidence intervals for categorical
187 outcomes. To test the consistency of the primary outcome across centres, we used the Mantel-
188 Haenszel homogeneity test. The incidence of each adverse event (cord rupture and uterine inversion)
189 was expressed as a proportion with binomial exact confidence intervals.

190 An analysis including women who had a caesarean delivery after randomization (for a total of 2172
191 and 2180 women in the CCT and SPE groups, respectively), for secondary outcomes available in these
192 women (mean change in Hb, mean change in Ht, postpartum transfusion, arterial embolization or
193 emergency surgery) was conducted.

194 A post-hoc “per protocol” analysis was conducted among women who were managed in accordance
195 with the protocol and the allocation, i.e who had all the following procedures: prophylactic oxytocin
196 administration at birth, cord clamping and cutting within 2 minutes, management of placenta
197 expulsion in accordance with the allocation group (CCT or SPE) and blood collection bag left in place
198 at least 15 minutes.

199 Software used for analysis was Stata 10.1 (Stata Corporation, USA).

200 *Ethics*

201 The trial protocol was approved by the Paris-Ile de France III Committee for the Protection of
202 Research Subjects (Ethics Committee) in September 2009 (n°B90885-20).

203 *Registration*

204 This trial is registered (ClinicalTrials.gov), number NCT01044082.

205 The full trial protocol can be accessed at: <http://www.u953.idf.inserm.fr/page.asp?page=5211>

206 **RESULTS**

207 **RESULTS**

208 Figure 1 shows the trial profile. The trial was carried out in all five hospitals between 1 January 2010
209 and 31 January 2011. In all, 4355 women in labour were enrolled and randomly assigned. After
210 randomization and before delivery, 294 (6.8%) women became ineligible because an intrapartum
211 caesarean was performed, and 3 others declined to participate. Thus 4058 randomized participants
212 delivered vaginally: 2034 assigned to CCT and 2024 to SPE. Baseline demographic and obstetric
213 characteristics were similar in the two groups (Table1).

214 The management of the third stage of labour is described in Table 2. Overall, the adherence to the
215 protocol was high in both groups. The reasons for deviating from the allocated intervention are
216 detailed in Figure1.

217 Primary outcome data were collected for 4013 (98.9%) participants. The proportion of women with a
218 measured postpartum blood loss of 500mL or more at bag removal did not differ between the 2 groups
219 (196/2005, 9.8% in the CCT group and 206/2008, 10.3% in the SPE group, relative risk 0.95, 95% CI
220 (0.79;1.15))(Table 3). There was no significant heterogeneity between centres for this result (Table3).

221 Similarly, the incidence of PPH \geq 1000mL at bag removal did not differ between the 2 groups; nor did
222 the mean measured blood loss at 15 minutes and at removal of the bag (Table3).

223 Outcome data related to blood count indicators before and after delivery were available for
224 1963/2034(96.5%) women in the CCT group and 1953/2024 (96.5%) in the SPE group (at least one
225 peripartum change in Hb or Ht available). Twenty women (11 in the CCT group and 9 in the SPE
226 group) had transfusion before day 2 and were excluded from this analysis. There was no significant
227 difference in the mean peripartum change in Hb or Ht (Table3). The proportion of women with a

228 peripartum drop in Hb of 4g/dl or more did not differ between the 2 groups, 2.1% (41/1961) in the
229 CCT group and 1.8% (35/1953) in the SPE group, (RR 1.17, 95% CI (0.75;1.82)).
230 Women in the CCT group had fewer manual removals of the placenta than those in the SPE group
231 (RR 0.69, 95% CI (0.53; 0.90)) (Table 3). Third stage was shorter in the CCT group.
232 Regarding safety, no uterine inversion occurred among the 1943 women who had controlled cord
233 traction (incidence 0.0%, one sided 97.5% CI (0.0%-0.18%)). Cord rupture occurred in 89 (incidence
234 4.6%, 95% CI (3.6%; 5.5%); among those 89 women, manual removal of the placenta was needed in
235 43 (48%). No other adverse events occurred in the two groups.
236 Women in the CCT group reported a significantly lower intensity of pain and discomfort during the
237 third stage than those in the SPE group; they were less likely to have felt tired and anxious and to
238 report that the duration of third stage was long (Table 4).
239 The per-protocol analysis was conducted in 1437/1999(71.9%) women in the CCT arm, and
240 1574/1990 (79.1%) in the SPE arm. The proportion of women with a measured postpartum blood loss
241 of 500mL or more at bag removal did not differ between the two groups (11.7% (168/1431) in the
242 CCT group and 10.7% (168/1570) in the SPE group, relative risk 1.10, 95% CI (0.90 ;1.34)).
243 Finally, the analysis including women who had a caesarean delivery after randomization provided
244 results similar to those of the main analysis (data not shown).

245

246 **DISCUSSION**

247 In this large multicenter randomized trial, we found that the use of controlled cord traction as one
248 component of the active management of third stage of labour had no significant effect on the incidence
249 of PPH. However, CCT reduced the duration of the third stage and the need for manual removal of
250 placenta. Moreover, women in the CCT group reported a significantly lower intensity of pain and
251 discomfort as well as less fatigue and anxiety.

252 This trial included a large population of pregnant women with few exclusion criteria. Hence, the
253 results are likely to be generalizable to women with vaginal deliveries in similar contexts of care.

254 Moreover, the adherence to the allocated intervention and other standardized aspects of third stage
255 management was high, making it possible to isolate the effect of CCT.

256 It was not possible to blind this intervention as the procedures being tested require different actions by
257 the attendants. However, the trial primary and main secondary outcomes (change in peripartum Hb
258 and Ht) were objective measures of postpartum blood loss as opposed to other definitions of PPH
259 based on visual estimation or interventions, influenced by caregiver decisions. Although the quality of
260 the CCT technique was not formally evaluated, a real difference in the management of placenta
261 expulsion between the 2 groups is very likely given the emphasis on the initial training. Moreover, the
262 attendants in the two groups clearly reported different procedures, and the length of the third stage was
263 significantly shorter and the incidence of cord rupture higher in the CCT group.

264 Two small trials in the 1960's (19, 22, 27) assessed the specific effects of CCT during the third stage.
265 Both had important methodological weaknesses including inadequate method of randomization, visual
266 estimation of blood loss for determining outcome measures and limited sample sizes. Very recently, a
267 large randomized controlled trial conducted in eight low and middle income countries compared CCT
268 with "hands-off " management of third stage(23) . The results showed that the omission of CCT did
269 not result in an increased risk of measured blood loss of 1000 mL or more. However, heterogeneity
270 between centres in other components of third stage management (type of uterotonic used, combination
271 with uterine massage), absence of report on the actual duration of blood loss measurement in each arm
272 and absence of outcomes based on blood counts, may limit the interpretation of the results. In addition,
273 although it is of major importance to conduct research studies in low and middle income countries, the
274 generalizability of their results for high income settings needs to be tested. Indeed, characteristics of
275 women, management of labour, resources and organization of care in the labour ward clearly differ
276 between low and high resource countries, and these differences may impact the risk and the
277 characteristics of PPH. Mechanisms of PPH and effective preventive procedures may differ between
278 settings. It is noteworthy that the incidence of PPH \geq 500 mL in the reference group of the previous
279 CCT trial was about 30% higher than the incidence found in the Tracor trial, which might indicate
280 higher exposure to the risk of PPH. For these reasons, our results provide valuable additional evidence

281 that CCT is not an essential component of management of the third stage of labour for prevention of
282 PPH, in high resource countries.

283 Cord rupture occurred in about 1 in 22 women who had CCT. This rate may appear notable at first.
284 However, in the majority of cases (52%), delivery of the placenta occurred without any extra
285 intervention; and overall, the rate of manual removal of placenta was lower in women who had CCT.
286 In consequence, cord rupture should not be considered an important adverse effect of CCT and does
287 not imply manual removal of placenta.

288 The 30% reduction in the need for manual removal of placenta found in the CCT arm may provide a
289 meaningful decrease in morbidity considering the need for analgesia and antibiotics, separation of
290 mother and baby, and the risk of infection associated with this intervention (28). However, we cannot
291 exclude the possibility that such a difference may have been less important (or even not significant) if
292 the French policy was more conservative, allowing a duration of third stage greater than 30 minutes
293 before manually removing the placenta, in particular in the SPE group. Our finding of a lower risk of
294 manual removal of placenta when its expulsion is managed with CCT is in contrast with the
295 conclusions of the trial cited above(29). However, in this study, manual removal of placenta was
296 performed in less than 1% of deliveries in both arms, which is low in comparison with previous
297 reports from high resource countries (30, 31), and may actually illustrate the variations in policies for
298 the management of the third stage of labour between settings (32). Our trial also showed that CCT
299 significantly reduced the duration of third stage. This result may have implications for optimizing the
300 organization of postpartum surveillance and care, in particular in hospitals where the number of
301 midwives or birth attendants in labour wards is limited. In addition, the shorter third stage and lesser
302 need for manual removal of placenta associated with CCT are likely to be the main reasons why
303 women reported a better experience of the third stage of labour in the CCT arm, although we cannot
304 exclude a patient preference bias since the study was not blinded.

305 Another controversial aspect of the management of the third stage of labour is the timing of cord
306 clamping. Recent results from a trial conducted in Sweden showed that, even in a region with low
307 prevalence of iron deficiency, delayed cord clamping reduced the prevalence of neonatal anaemia and

308 improved iron status at 4 months of age in term deliveries (33), confirming the findings of previous
309 trials conducted in low and middle income populations(34). CCT, as it is classically performed, is not
310 compatible with delayed cord clamping. Our finding that CCT has no significant effect on maternal
311 postpartum haemorrhage constitutes reassuring information for clinicians willing to implement a
312 policy of delayed cord clamping, from both maternal and neonatal perspectives.

313 In a high-resource setting, the use of CCT for the management of placenta expulsion has no significant
314 effect on the incidence of PPH and other markers of postpartum blood loss. Therefore, there is no
315 evidence to recommend routine CCT for the management of placenta expulsion in order to prevent
316 PPH.

317

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326

327 **Contribution of authors**

328 CDT participated in the design of the study, obtained funding participated in the central monitoring of
329 data collection, supervised the cleaning, analysis, and interpretation of the data and the drafting and
330 revision of the paper, and has seen and approved the final version. She had full access to all of the data
331 in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

332 As the Corresponding Author, she has the right to grant on behalf of all authors and does grant on
333 behalf of all authors, an exclusive licence on a worldwide basis to the BMJ Publishing Group Ltd and
334 its Licensees to permit this article (if accepted) to be published in BMJ editions and any other
335 BMJPGJ products and sublicences to exploit all subsidiary rights.

336 LS participated in the design of the study, supervised the inclusion of women and the running of the
337 trial in his hospital, participated in the revision of the paper, and has seen and approved the final
338 version.

339 FM participated in the central monitoring of data collection, supervised the cleaning of the data,
340 conducted the analysis and participated in the drafting and the revision of the paper and has seen and
341 approved the final version.

342 EC participated in the design of the study, supervised the inclusion of women and the running of the
343 trial in his hospital, participated in the revision of the paper, and has seen and approved the final
344 version.

345 DV participated in the design of the study, supervised the inclusion of women and the running of the
346 trial in her hospital, participated in the revision of the paper, and has seen and approved the final
347 version.

348 JL participated in the design of the study, supervised the inclusion of women and the running of the
349 trial in his hospital, participated in the revision of the paper, and has seen and approved the final
350 version.

351 FG is the principal investigator of the trial; he participated in the design of the study, obtained funding
352 for it, participated in the central monitoring of data collection, supervised the cleaning, analysis, and
353 interpretation of the data and the drafting and revision of the paper, and has seen and approved the
354 final version. He had full access to all of the data in the study and takes responsibility for the integrity
355 of the data and the accuracy of the data analysis.

356

357 All authors have completed the ICMJE uniform disclosure form at www.icmje.org/coi_disclosure.pdf
358 (available on request from the corresponding author) and declare: had support from the French
359 Ministry of Health for the submitted work; LS had relationships (board membership, consultancy and
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363

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369

370 Data sharing: no additional data available.

371

372 **References**

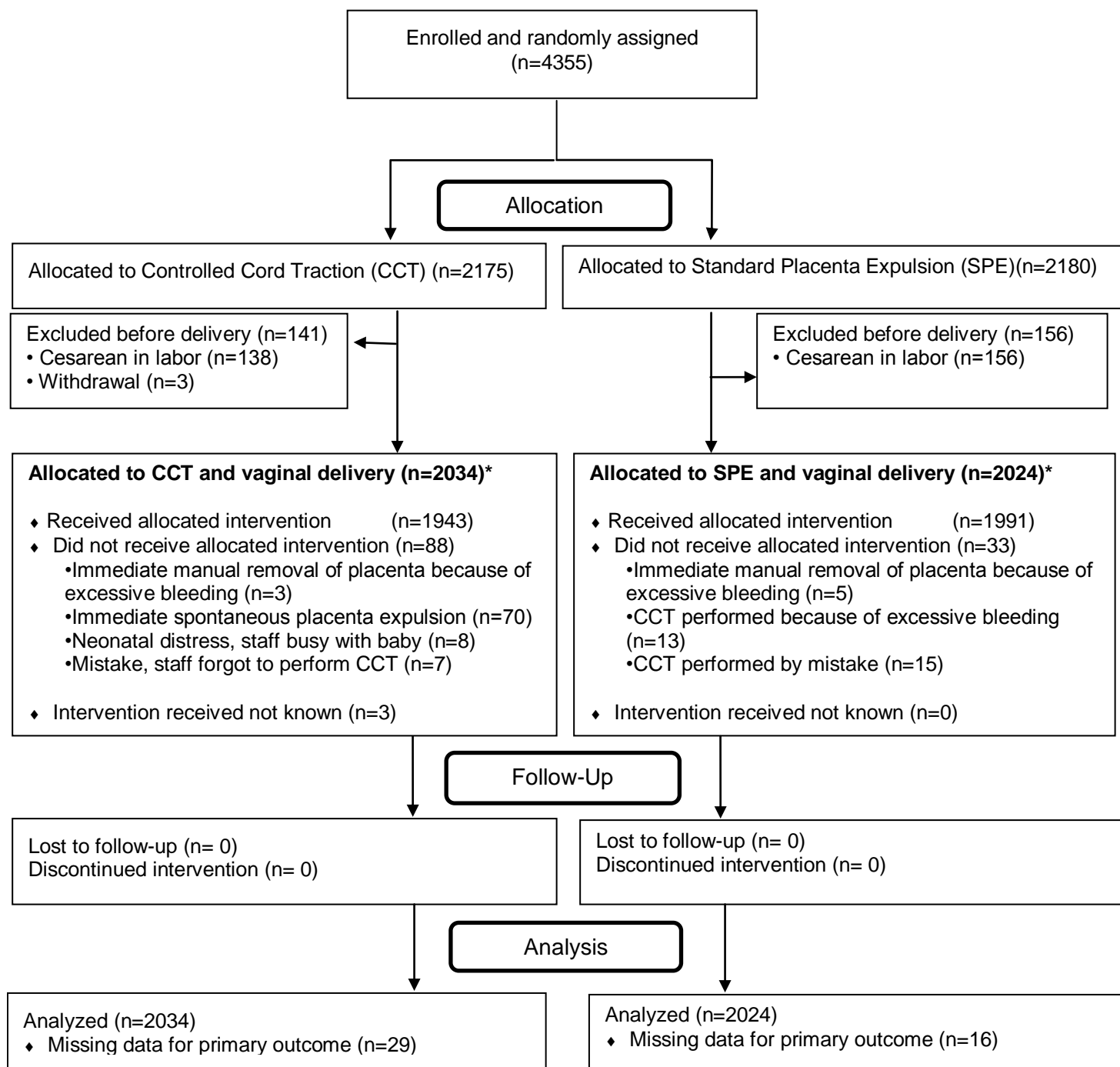
- 373 1. Khan KS, Wojdyla D, Say L, Gulmezoglu AM, Van Look PF. WHO analysis of causes of maternal
374 death: a systematic review. *Lancet*. 2006;367(9516):1066-74.
- 375 2. Callaghan WM, Mackay AP, Berg CJ. Identification of severe maternal morbidity during
376 delivery hospitalizations, United States, 1991-2003. *Am J Obstet Gynecol*. 2008;199(2):133 e1-8.
- 377 3. Zhang WH, Alexander S, Bouvier-Colle MH, Macfarlane A. Incidence of severe pre-eclampsia,
378 postpartum haemorrhage and sepsis as a surrogate marker for severe maternal morbidity in a
379 European population-based study: the MOMS-B survey. *Bjog*. 2005;112(1):89-96.
- 380 4. Zwart J, Richters J, Öry F, de Vries J, Bloermeenkamp K, van Roosmalen J. Severe maternal
381 morbidity during pregnancy, delivery and puerperium in the Netherlands: a nationwide population-
382 based study of 371 000 pregnancies. *BJOG*. 2008;115:842-50.
- 383 5. Brace V, Penney G, Hall M. Quantifying severe maternal morbidity: a Scottish population
384 study. *Bjog*. 2004;111(5):481-4.
- 385 6. Oyelese Y, Ananth CV. Postpartum hemorrhage: epidemiology, risk factors, and causes.
386 *Clinical obstetrics and gynecology*. 2010;53(1):147-56. Epub 2010/02/10.
- 387 7. World Health Organization. Recommendations for the prevention of postpartum
388 haemorrhage. Geneva:World Health Organization.
389 2007:http://apps.who.int/rhl/effective_practice_and_organizing_care/guideline_pphprevention_fawoleb/en/index.html.
- 390
- 391 8. Begley CM. A comparison of 'active' and 'physiological' management of the third stage of
392 labour. *Midwifery*. 1990;6(1):3-17.
- 393 9. Khan GQ, John IS, Wani S, Doherty T, Sibai BM. Controlled cord traction versus minimal
394 intervention techniques in delivery of the placenta: a randomized controlled trial. *Am J Obstet*
395 *Gynecol*. 1997;177(4):770-4.
- 396 10. Prendiville WJ, Harding JE, Elbourne DR, Stirrat GM. The Bristol third stage trial: active versus
397 physiological management of third stage of labour. *Bmj*. 1988;297(6659):1295-300.
- 398 11. Rogers J, Wood J, McCandlish R, Ayers S, Truesdale A, Elbourne D. Active versus expectant
399 management of third stage of labour: the Hinchingsbrooke randomised controlled trial. *Lancet*.
400 1998;351(9104):693-9.
- 401 12. Begley CM, Gyte GM, Devane D, McGuire W, Weeks A. Active versus expectant management
402 for women in the third stage of labour. *Cochrane database of systematic reviews* (Online).
403 2011(11):CD007412. Epub 2011/11/11.
- 404 13. Lalonde A, Daviss BA, Acosta A, Herschderfer K. Postpartum hemorrhage today: ICM/FIGO
405 initiative 2004-2006. *Int J Gynaecol Obstet*. 2006;94(3):243-53. Epub 2006 Jul 12.
- 406 14. World Health Organization. WHO recommendations for the prevention of postpartum
407 haemorrhage. Geneva:World Health Organization Department of making pregnancy safer.
408 2007(http://www.who.int/making_pregnancy_safer/publications/WHORRecommendationsforPPHaeorrhage.pdf).
- 409
- 410 15. Goffinet F, Mercier F, Teyssier V, Pierre F, Dreyfus M, Mignon A, et al. [Postpartum
411 haemorrhage: recommendations for clinical practice by the French College of Obstetricians and
412 Gynecologists (December 2004)]. *Gynecol Obstet Fertil*. 2005;33(4):268-74. Epub 2005/05/17.
- 413 16. Leduc D, Senikas V, Lalonde AB, Ballerman C, Biringer A, Delaney M, et al. Active
414 management of the third stage of labour: prevention and treatment of postpartum hemorrhage.
415 *Journal of obstetrics and gynaecology Canada : JOGC = Journal d'obstetrique et gynecologie du*
416 *Canada : JOGC*. 2009;31(10):980-93. Epub 2009/11/28.
- 417 17. Royal College of Obstetricians and Gynecologists. Green Top Guideline n°52. Prevention and
418 management of postpartum haemorrhage.May 2009. available at :
419 <http://www.rcog.org.uk/files/rcog-corp/GT52PostpartumHaemorrhage0411.pdf>.
- 420 18. Cotten A, Ness A, Tolosa J. Prophylactic use of oxytocin for the third stage of labour.
421 *Cochrane database of systematic reviews* (Online). 2010(2):CD001808.

- 422 19. Bonham DG. Intramuscular Oxytocics and Cord Traction in Third State of Labour. *Br Med J.*
423 1963;2(5373):1620-3.
- 424 20. Winter C, Macfarlane A, Deneux-Tharaux C, Zhang WH, Alexander S, Brocklehurst P, et al.
425 Variations in policies for management of the third stage of labour and the immediate management of
426 postpartum haemorrhage in Europe. *Bjog.* 2007;114(7):845-54.
- 427 21. Goffinet F. Inversion uterine. In: Cabrol D., Pons JC., Goffinet F., editors. *Traite d'obstetrique.*
428 Paris: Flammarion Medecine-Sciences; 2003. p. 941-4.
- 429 22. Kemp J. A review of cord traction in the third stage of labour from 1963 to 1969. *Med J Aust.*
430 1971;1(17):899-903.
- 431 23. Gulmezoglu AM, Lumbiganon P, Landoulsi S, Widmer M, Abdel-Aleem H, Festin M, et al.
432 Active management of the third stage of labour with and without controlled cord traction: a
433 randomised, controlled, non-inferiority trial. *Lancet.* 2012;379(9827):1721-7. Epub 2012/03/09.
- 434 24. Zhang WH, Deneux-Tharaux C, Brocklehurst P, Juszczak E, Joslin M, Alexander S. Effect of a
435 collector bag for measurement of postpartum blood loss after vaginal delivery: cluster randomised
436 trial in 13 European countries. *BMJ.* 2010;340:c293. Epub 2010/02/04.
- 437 25. Rath WH. Postpartum hemorrhage--update on problems of definitions and diagnosis. *Acta*
438 *Obstet Gynecol Scand.* 2011;90(5):421-8.
- 439 26. Deneux-Tharaux C, Dupont C, Colin C, Rabilloud M, Touzet S, Lansac J, et al. Multifaceted
440 intervention to decrease the rate of severe postpartum haemorrhage: the PITHAGORE6 cluster-
441 randomised controlled trial. *Bjog.* 2010;117(10):1278-87.
- 442 27. Althabe F, Buekens P, Sosa C, Belizan JM. Controlled cord traction in the third stage of labor.
443 Systematic review. *International journal of gynaecology and obstetrics: the official organ of the*
444 *International Federation of Gynaecology and Obstetrics.* 2006;94(S2):S126-7.
- 445 28. Chongsomchai C, Lumbiganon P, Laopaiboon M. Prophylactic antibiotics for manual removal
446 of retained placenta in vaginal birth. *Cochrane database of systematic reviews (Online).*
447 2006(2):CD004904. Epub 2006/04/21.
- 448 29. Gulmezoglu AM, Lumbiganon P, Landoulsi S, Widmer M, Abdel-Aleem H, Festin M, et al.
449 Active management of the third stage of labour with and without controlled cord traction: a
450 randomised, controlled, non-inferiority trial. *Lancet.* 2012. Epub 2012/03/09.
- 451 30. Cheung WM, Hawkes A, Ibish S, Weeks AD. The retained placenta: historical and geographical
452 rate variations. *Journal of obstetrics and gynaecology : the journal of the Institute of Obstetrics and*
453 *Gynaecology.* 2011;31(1):37-42. Epub 2011/02/02.
- 454 31. Weeks AD. The retained placenta. *Best practice & research Clinical obstetrics & gynaecology.*
455 2008;22(6):1103-17. Epub 2008/09/17.
- 456 32. Deneux-Tharaux C, Macfarlane A, Winter C, Zhang WH, Alexander S, Bouvier-Colle MH.
457 Policies for manual removal of placenta at vaginal delivery: variations in timing within Europe. *Bjog.*
458 2009;116(1):119-24.
- 459 33. Andersson O, Hellstrom-Westas L, Andersson D, Domellof M. Effect of delayed versus early
460 umbilical cord clamping on neonatal outcomes and iron status at 4 months: a randomised controlled
461 trial. *Bmj.* 2011;343:d7157. Epub 2011/11/18.
- 462 34. Hutton EK, Hassan ES. Late vs early clamping of the umbilical cord in full-term neonates:
463 systematic review and meta-analysis of controlled trials. *JAMA : the journal of the American Medical*
464 *Association.* 2007;297(11):1241-52. Epub 2007/03/22.

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Figure 1: Trial flow diagram



* During the inclusion period, 12 391 women meeting the inclusion criteria had vaginal deliveries at the 5 participating hospitals; the trial thus recruited 32.7% (4058/12391) of the eligible women. The exact number of women assessed for eligibility was not collected.

Table 1. Baseline characteristics of women

Characteristics	Controlled Cord Traction (N= 2034)	Standard Placenta Expulsion (N= 2024)
Hospital		
A	485/2034 (23.8)	489/2024 (24.1)
B	213/2034 (10.5)	202/2024 (10.0)
C	345/2034 (17.0)	332/2024 (16.4)
D	446/2034 (21.9)	443/2024 (21.9)
E	545/2034 (26.8)	558/2024 (27.6)
Age (years) (mean (SD) (n))	30.2 (5.2) (2034)	30.0 (5.2) (2024)
French nationality	1838/2000 (91.9)	1814/1995 (90.9)
Body Mass Index (mean (SD)(n))	22.8 (4.3) (2031)	22.7 (4.1) (2017)
Nulliparous	1074/2030 (52.9)	1031/2010 (51.3)
Previous PPH ^a	43/2030 (2.1)	39/2010 (1.9)
Uterine scar	132/2033 (6.5)	120/2021 (5.9)
Prenatal Hb ^b (g/dL) (mean (SD) (n))	12.0 (1.0) (2005)	12.0 (1.0) (1990)
Prenatal Ht ^c (%) (mean (SD) (n))	35.6 (1.0) (1952)	35.5 (2.9) (1933)
GA ^d at delivery (wks) (mean (SD) (n))	39.4 (1.2) (2034)	39.4 (1.2) (2024)
Induction of labour	381/2034 (18.7)	406/2024 (20.1)
Epidural analgesia	1975/2033 (97.1)	1957/2023 (96.7)
Oxytocin during labour (1 st and 2 nd stages)	1352/2033 (66.5)	1362/2020 (67.4)
Instrumental delivery	367/2034 (18.0)	381/2024 (18.8)
Episiotomy	597/2034 (29.3)	586/2024 (29.0)
Perineal tear	1036/2033 (51.0)	1024/2024 (50.6)
Birth weight (grams) (mean (SD) (n))	3365 (428) (2032)	3390 (433) (2022)
Birth weight ≥ 4000 grams	159/2032 (7.8)	157/2022 (7.8)

Data are n/N (%) unless otherwise stated

^a Postpartum haemorrhage

^b Haemoglobin

^c Haematocrit

^d Gestational age

Table 2. Adherence to allocated intervention and other aspects of third stage management

	Controlled Cord Traction	Standard Placenta Expulsion
Prophylactic oxytocin administration at birth	1977/2029 (97.4)	1961/2022 (97.0)
Cord clamping and cutting within 2 minutes of birth	1933/2026 (95.4)	1944/2019 (96.3)
Cord management according to protocol	1943/2031 (95.7) ^a	1991/2024 (98.4) ^a
Blood collection bag	2016/2028 (99.4)	2015 (2020 (99.7)
Duration of blood collection (min) (mean (SD) (n))	27 (16) (1990)	29 (16) (1987)
Blood collection bag in place \geq 15 minutes	1609/2002 (80.4)	1717/1992 (86.2)

Data are n/N (%) unless otherwise stated

^a The reasons why 88 women in the CCT group and 33 women in the SPE group did not receive the allocated intervention are mentioned in Figure 1

Table 3. Trial outcomes

	Controlled Cord Traction	Standard Placenta Expulsion	Risk ratio (95% CI)	Mean difference (95% CI)
Blood loss \geq 500mL	196/2005 (9.8)	206/2008 (10.3)	0.95 (0.79-1.15)	/
By hospital			0.31 ^a	
A	46/473 (9.7)	37/482 (7.7)	1.27 (0.84-1.92)	/
B	20/199 (10.1)	14/196 (7.1)	1.41 (0.73-2.71)	/
C	40/344 (11.6)	49/330 (14.9)	0.78 (0.53-1.16)	/
D	38/445 (8.5)	42/443 (9.5)	0.90 (0.59-1.37)	/
E	52/544 (9.6)	64/557 (11.5)	0.83 (0.59-1.18)	/
Blood loss \geq 1000 mL	34/2005 (1.7)	37/2008 (1.8)	0.92 (0.58-1.46)	/
Blood loss at 15 minutes (mL) (mean (SD) (n))	163 (4) (2005)	161 (4) (2001)	/	1.7 (-8.8;12.2)
Total blood loss (mL) (mean (SD) (n))	207 (5) (2005)	217 (6) (2008)	/	-9.4 (-24.8;6.0)
Blood transfusion for PPH	12/2034 (0.6)	9/2024 (0.4)	1.33 (0.56-3.14)	/
Arterial embolization/surgery for PPH	3/2034 (0.1)	5/2024 (0.3)	0.60 (0.14-2.49)	/
Peripartum change in Hb ^b (g/dL) (mean (SD) (n))	0.9 (0.0) (1961)	0.9 (0.0) (1953)	/	-0.02 (-0.10;0.07)
Peripartum change in Ht ^c (%) (mean (SD) (n))	2.1 (0.1) (1904)	2.2 (0.1) (1890)	/	-0.05 (-0.29;0.19)
Duration of third stage (min) (mean (SD) (n))	5.5 (0.1) (2030)	8.7 (0.1) (2020)	/	-3.26 (-3.62; -2.90)
Third stage \geq 15 min	91/2030 (4.5)	289/2020 (14.3)	0.31 (0.25-0.39)	/
Manual removal of placenta	85/2033 (4.2)	123/2024 (6.1)	0.69 (0.53-0.90)	/
Additional uterotonics after placenta delivery	727/2030 (35.8)	805/2024 (39.8)	0.92 (0.83-0.97)	/
Maternal pain during 3 rd stage	109/1892 (5.8)	138/1868 (7.4)	0.78 (0.61-0.99)	/
Cord rupture	89/2034 (4.4)	2/2024 (0.1)	44.3 (10.9-179.6)	/

Uterine inversion	0/2034 (0.0)	0/2024 (0.0)	/	/
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Data are n/N (%) unless otherwise stated

^a p for Mantel-Haenszel test of homogeneity across centers

^b Prepartum Hb measured within 8th month of gestation and arrival in labour ward in 1778 (90.7%) and 1760 (90.1%), at arrival in labour ward in 95 (4.8%) and 99 (5.1%) and between the 5th-7th months of gestation in 88 (4.5%) and 94 (4.8%), in the CCT and SPE groups, respectively ; postpartum Hb measured at Day 2 in 1793 (91.4%) and 1787 (91.5%), and on another day between 1 and 8 days in 168 (8.6%) and 166 (8.5%) , in the CCT and SPE groups, respectively.

^c Prepartum Ht measured within 8th month of gestation and arrival in labour ward in 1724 (90.5%) and 1707 (90.3%), at arrival in labour ward in 95 (5.0%) and 99 (5.2%) and between the 5th-7th months of gestation in 85 (4.5%) and 84 (4.4%), in the CCT and SPE groups, respectively; postpartum Ht measured at Day 2 in 1737 (91.2%) and 1725 (91.3%), and on another day between 1 and 8 days in 167 (8.8%) and 165 (8.7%) , in the CCT and SPE groups, respectively.

Table 4. Women's experience of third stage

		Controlled Cord Traction	Standard Placenta Expulsion	P ^a
Completed forms		1838/2034 (90.4)	1844/2024 (91.2)	0.41
Felt tired	Not at all	466/1829 (25.5)	426/1838 (23.2)	
	A little	656/1829 (35.9)	621/1838 (33.8)	
	Moderately	378/1829 (20.6)	445/1838 (24.2)	0.017
	Very	252/1829 (13.8)	285/1838 (15.5)	
	Extremely	77/1829 (4.2)	61/1838 (3.3)	
Felt anxious	Not at all	1191/1821 (65.4)	1073/1821 (58.9)	
	A little	398/1821 (21.9)	475/1821 (26.1)	
	Moderately	154/1821 (8.5)	168/1821 (9.2)	<0.001
	Very	59/1821 (3.2)	94/1821 (5.2)	
	Extremely	19/1821 (1.0)	11/1821 (0.6)	
Felt 3 rd stage was long	Not at all	1590/1830 (86.9)	1451/1833 (79.2)	
	A little	137/1830 (7.5)	219/1833 (11.9)	
	Moderately	68/1830 (3.7)	110/1833 (6.0)	<0.001
	Very	23/1830 (1.2)	43/1833 (2.4)	
	Extremely	12/1830 (0.7)	10/1833 (0.5)	
Felt satisfied	Not at all	4/1832 (0.2)	3/1840 (0.2)	
	A little	6/1832 (0.3)	11/1840 (0.6)	
	Moderately	63/1832 (3.4)	81/1840 (4.4)	0.21
	Very	716/1832 (39.1)	751/1840 (40.8)	
	Extremely	1043/1832 (57.0)	994/1840 (54.0)	
Discomfort ^b	≤ 2	1408/1830 (76.9)	1285/1834 (70.1)	
	3-7	371/1830 (20.3)	475/1834 (25.9)	<0.001
	≥ 8	51/1830 (2.8)	74/1834 (4.0)	
Pain intensity ^c	≤ 2	1475/1828 (80.7)	1362/1837 (74.1)	
	3-7	309/1828 (16.9)	413/1837 (22.5)	<0.001
	≥ 8	44/1828 (2.4)	62/1837 (3.4)	

Data are n/N (%)

^a Chi2 test^b graded from 0 (no discomfort) to 10^c graded from 0 (no pain) to 10