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► To cite this version:

Anne Pinton, Catherine Deneux-Tharaux, Aurélien Seco, Loïc Sentilhes, Gilles Kayem. Incidence and Risk Factors for Severe Postpartum Hemorrhage in Women with Anterior-Low-Lying or Previa Placenta and Prior Cesarean: Prospective Population-Based Study Authors. *British Journal of Obstetrics and Gynaecology*, 2023, 130 (13), pp.1653. <10.1111/1471-0528.17554>. <hal-04947022>

HAL Id: hal-04947022

<https://hal.science/hal-04947022v1>

Submitted on 14 Feb 2025

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Title Page

Title

Incidence and Risk Factors for Severe Postpartum Hemorrhage in Women with Anterior-Low-Lying or Previa Placenta and Prior Cesarean: Prospective Population-Based Study

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On behalf of the PACCRETA Study Group

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26

27 **Short title:**

28 PPH in women with previa placenta and prior cesarean

29 **Word count:**

30 Abstract: 250 words

31 Main Text: 2504 words

32 **Abstract page**

33 **Abstract**

34 Objective: To assess the incidence and risk factors for severe postpartum hemorrhage (PPH) in
35 women with an anterior-low-lying or previa placenta, prior cesarean, and no prenatal suspicion
36 of placenta accreta spectrum (PAS).

37 Design: Population-based study in 176 maternity units in France.

38 Population: All women with anterior-low-lying (0-19 mm from the cervical internal os) or previa
39 placenta, diagnosed prospectively before birth, prior caesarean and no prenatal suspicion of
40 PAS.

41 Methods: Multivariable logistic regression to identify risk factors for severe PPH in the main
42 population and after exclusion of women with PAS diagnosed only at birth.

43 Main Outcome Measures: Severe PPH defined by a composite criterion either estimated blood
44 loss of 1500 ml or more, transfusion of 4 or more units of packed red blood cells, embolization,
45 or surgical treatment.

46 Results: Of the 520,114 women comprising the source population, 230 (0.44 per 1000 women;
47 95%CI, 0.38-0.50) met the inclusion criteria. Severe PPH rate was 24.8% (95%CI, 19.2-30.4)
48 overall, 27.5% (95%CI, 21.8-33.3) in women with placenta previa and 15.4% (95%CI, 10.7-20.0)
49 in women with low-lying placenta. PAS was diagnosed at birth in 22 women (9.9%; 95%CI, 5.8-
50 13.4), although previously unsuspected. After their exclusion, severe PPH incidence was 17.3%

51 (95%CI, 12.4-22.2). In multivariate analysis, the only factor associated with a higher severe PPH
52 risk was placenta previa (aOR, 3.65; 95%CI, 1.20-15.8).

53 Conclusion: Severe PPH is frequent among women with anterior-low-lying or previa placenta
54 and prior caesarean, even after exclusion of women with PAS. The risk of severe PPH almost
55 doubles when the placenta is previa versus low-lying.

56

57 Funding: French Health Ministry and the Angers University Hospital (grant number: AOR12156).

58 Keywords: obstetric haemorrhage, placental pathology, delivery: caesarean section.

59 Main Text

60 Introduction

61 As the rates of cesarean delivery have risen over the past three decades, reaching and even
62 surpassing 30% in many high-resource countries, parturients with a prior cesarean delivery
63 have become common (1–3). A prior cesarean is associated with a higher incidence of
64 abnormally located placentas — either previa or anterior-low-lying (4). These two combined
65 conditions (an anterior-low-lying or previa placenta and prior caesarean) are associated with a
66 high prevalence of placenta accreta spectrum (PAS), which is considered the principal risk in
67 these women, given the major maternal morbidity and even death associated with it (5–7).

68 For this reason, it is recommended that women with this combination of risk factors undergo
69 appropriate diagnostic investigations to detect PAS; if it is suspected, these women should be
70 referred to expert centers, which have the appropriate technical support and human resources
71 for these potentially challenging cases of severe PPH. This specialized care is associated with
72 reduced maternal morbidity (8,9).

73 However, the risk of maternal morbidity in these women when PAS is not suspected has not
74 been adequately assessed, and the appropriate place of delivery and resources (including
75 Intensive care unit or blood bank on site) is not clear. North American and European guidelines
76 are heterogeneous and cover the subject only partially, due to the lack of data for this specific
77 population (8–13).

78 Some studies have reported rates of severe PPH in women with an anterior-low-lying or previa
79 placenta (14–18) and others in women with this placental location and a prior cesarean (19–23).

80 These studies, however, have included women with PAS diagnosed before birth, a context with
81 a well-known high risk of hemorrhagic complications (15,17,19–21). Its referral center-based
82 design makes the external validity of its results questionable, as the women managed in such
83 centers may not be representative of the entire population.

84 Our objective was to apply a population-based approach to identify women with previa or
85 anterior-low-lying placental location and prior cesareans without prenatally suspected PAS and
86 to assess the incidence and risk factors for severe PPH among them.

87 **Methods**

88 **Design: Population-based cohort study.**

89 **Source population: the PACCRETA study**

90 The PACCRETA study took place in 176 French maternity hospitals in 12 regions over a two-year
91 period, between November 1, 2013, and October 31, 2015. It provided a source population of
92 520,114 deliveries, 30% of the national total over this period (24).

93 Recruitment and data collection started only after women had received information about the
94 study and agreed to participate. The appropriate ethics committees (Consultative Committee
95 on the Treatment of Data on Personal Health for Research Purposes - reference n° AOR12156,
96 and the Committee for the Protection of People Participating in Biomedical Research -
97 reference CPP 13-017) and the National Data Protection Authority (CNIL n° DR-2013-427)
98 approved this study. The PACCRETA study protocol has previously been described (24). Briefly,
99 this study included all women with an anterior-low-lying (defined as a placenta from 0-19 mm
100 from the cervical internal os) or previa placenta (defined as covering the cervix) at their last
101 ultrasound scan and a prior cesarean.

102 First-, second-, and third-trimester obstetric ultrasound examinations are free of charge and
103 part of routine care in France. Therefore, nearly all PACCRETA participants had all three scans.
104 Sonographers routinely describe placental location during these scans. Only women whose
105 placenta remained anterior-low-lying or previa at the last ultrasound before birth were so
106 categorized and eligible for inclusion.

All women meeting the inclusion criteria of the PACCRETA study were identified prospectively during pregnancy and flagged by local coordinators at each participating center. They were included in the immediate postpartum period (i.e., live birth or stillbirth after 22 weeks of gestation).

Eligible population and inclusion criteria in this study

For the main analysis (study population 1), we included women with an anterior-low-lying or previa placenta, as defined above, and a prior caesarean, with no prenatal suspicion of PAS, defined by the signs of PAS on ultrasound or MRI examination, according to the clinical team responsible for her care (24,25). Women with a posterior low-lying placenta were excluded because there is no physiological rationale for an exclusively posterior placenta not located on the cesarean scar to affect maternal morbidity more than in the absence of such a scar (27). The previa group included all women with placenta previa — anterior or posterior.

A secondary analysis was conducted after exclusion of women with PAS diagnosed at birth but not suspected before (study population 2).

Primary outcome of this study

The primary outcome of this study was severe PPH, defined by a composite criterion: PPH with estimated blood loss of 1500 ml or more and/or requiring transfusion of 4 or more units of packed red blood cells and/or embolization and/or uterine-sparing surgical treatment and/or hysterectomy (28). Uterine-sparing surgical treatment was defined as uterine compression sutures, or surgical ligation of uterine or other pelvic arteries (29).

128 **Variables collected**

129 Clinical research midwives, consulting the delivery logbook and computerized databases at each
130 center, verified the exhaustiveness of case identification. They also prospectively collected
131 information for each woman included by manual review of the medical files. This information
132 included: 1) maternal characteristics and medical history, including age, body mass index,
133 parity, prior uterine surgery (curettage, or surgery by hysteroscopy, i.e., synechia removal or
134 myomectomy), and number of previous cesarean deliveries; 2) characteristics of the current
135 pregnancy, including placental location at the last ultrasound (previa or low-lying); 3)
136 characteristics of delivery, including gestational age at delivery, type of labor onset, and mode
137 of delivery; 4) maternal outcomes, including volume of postpartum blood loss, embolization,
138 uterine-sparing surgical treatment, hysterectomy, surgical complications, blood product
139 transfusion, and maternal transfer to ICU; 5) presence of PAS and whether it was diagnosed
140 before birth or not.

141 PAS was defined by the presence of at least one of the following clinical or histologic criteria, as
142 stated in the PACCRETA study protocol (24): 1) manual removal of the placenta partially or
143 totally impossible and no cleavage plane between part or all of the placenta and the uterus; 2)
144 massive bleeding from the implantation site after forced placental removal in the absence of
145 another cause of PPH; 3) histological confirmation of PAS on a hysterectomy specimen; 4) signs
146 of PAS at laparotomy in women with suspected PAS on prenatal imaging.

147

148 **Statistical analysis**

149 The population-based incidence of severe PPH in women with an anterior-low-lying or previa
150 placenta and prior caesarean with no suspicion of PAS before birth was calculated with its 95%
151 confidence interval (95% CI). We compared the characteristics of women with and without
152 severe PPH. Categorical variables were compared with Pearson's Chi2 test or Fisher's exact test,
153 and continuous variables with Student's t-test or Wilcoxon's rank-sum test, as appropriate.

154 Risk factors for severe PPH were identified through univariate then multivariate logistic
155 regression. Analysis was conducted in the study population 1 and in the study population 2.
156 Variables included in the multivariate model were selected based on the results of the
157 univariate analysis and the literature. The proportion of women with missing data ranged from
158 0% to 8,2% and 216 (93.9%) women had no missing data for any covariate included in the
159 multivariate model. Missing data were considered missing at random. We imputed missing data
160 by chained equations and computed 30 imputation datasets(30).

161 We used Stata/SE 15.0 (StataCorp LP, College Station, TX) to analyze the data.

Results

Of the 520,114 women who gave birth, 230 (0.44 per 1000 women; 95% CI, 0.38–0.50) had both an anterior-low-lying or previa placenta and prior caesarean but no prenatal suspicion of PAS (Figure 1).

The incidence of severe PPH in the main population (study population 1) was 24.8% (57/230) (95% CI, 19.2-30.4) (Table 1) and 50 women (21.7%) required red blood cell transfusion (Table 2). The severe PPH rate was 27.5% (49/178) (95% CI, 21.8-33.3) in women with placenta previa and 15.4% (8/52) (95% CI, 10.7-20.0) in women with low-lying placenta.

PAS was diagnosed at birth although previously unsuspected in 22 women (9.9% 95% CI 5.8-13.4) of whom 21 had a severe PPH (Table 1). Investigations and outcomes in these 22 women are described in Table S1.

After exclusion of women with PAS diagnosed at birth while not suspected before (study population 2), the incidence of severe PPH was 17.3% (36/208) (95% CI, 12.4-22.2) and 33 women (15.9%) required red blood cell transfusion (Table 2).

In the multivariate analysis, in the main population (study population 1), factors associated with a higher risk of severe PPH were PAS diagnosed at birth but unsuspected before (aOR: 99.0; 95% CI, 18.6-1856) and placenta previa compared with low-lying placenta (aOR: 3.18; 95% CI 1.13-11.7)(Table 3). In the study population 2, the only factor associated with a higher risk of severe PPH was placenta previa compared with a low-lying placenta (aOR: 3.65 95% CI 1.20-15.8) (Table 3).

Discussion

Main findings

The rate of severe PPH was 24.8% among the women with a placenta previa or anterior-low-lying, a previous cesarean, and without prenatally suspected PAS. Ten percent of these women nonetheless had PAS diagnosed at birth; after their exclusion, the incidence of severe PPH remained high (17.3%). The only independent risk factor for severe PPH was placenta previa, compared with a low-lying placenta.

Strengths and limitations

One strength of our study is its clinically relevant population — women with an anterior-low-lying or previa placenta and prior cesarean without prenatally suspected PAS. Although women with prenatally suspected PAS are best managed in specialized centers with multidisciplinary teams (8, 9), until now much less was known about the hemorrhage risk of women with the specific profile studied here and the maternal care resources they need (31,32). Another strength is its large-size and population-based design, which allows reliable estimates of the prevalence and risk factors for severe PPH in these women. Recruitment, case mix, PAS detection rates, and maternal morbidity may be very different from those of the general population in (single-center or multicenter) studies including tertiary or specialized centers; they would not provide “real world” rates (33,34). Moreover, unlike others (21), we had data about the precise location of the placenta and the distance between the placental edge and the cervical internal os. We were thus able to evaluate the risk of severe PPH according to the placental position in relation to the uterine cervical os.

A potential weakness, however, is that we may have missed some women with a low-lying placenta, especially when they were asymptomatic. However, because all pregnant women in France have a third-trimester ultrasound scan at 32/34 weeks of gestation, at which placenta location can be routinely checked, we believe that the rate of undetected women is low.

Interpretation

The originality of our study is its report of the prevalence of severe PPH in women with a prior cesarean and an anterior-low-lying or previa placenta, after excluding those with PAS suspected before birth. This situation is not rare in clinical practice, and these results may help physicians to inform their patients of the risk of severe PPH according to the prenatal risk factors and to plan delivery in hospitals with adequate resources. While it is now clear that women with prenatally suspected PAS are best managed in specialized centers with multidisciplinary teams (8,9), much less is known about the risk of hemorrhage in the subgroup of women who were the specific focus of our analysis and therefore about the resources they require in childbirth (31,32).

The rate of severe PPH was very high in our study — 24.8%. One other large multicenter study focused specifically on women with placenta previa who underwent primary caesarean; it excluded all PAS diagnosed at birth, regardless of whether or not it had been suspected earlier (23). The rate of severe PPH (defined as mortality, blood product transfusion, atony requiring uterotonics, uterine or hypogastric artery ligation, hysterectomy, coagulopathy, and/or exploratory laparotomy) was 20.5% in the placenta previa group, which is close to the 16% severe PPH rate reported in our secondary analysis excluding all PAS. However, this study did

not investigate the clinically relevant context of women with no prenatally suspected PAS and with prior caesarean and the risk of severe PPH according to the subtype of anterior-low-lying versus previa placenta.

Our prospective population-based study allowed us to investigate the risk factors for severe PPH in women with an anterior-low-lying or previa placenta and prior caesarean without PAS suspected before birth. Several studies, mainly single-center and retrospective, or multicenter and registry-based, have analyzed the risk factors for PPH in women with placenta previa or low-lying placenta (16,23,35–40). Few had data about PAS and a previous cesarean (16,17,36,39). None evaluated the risk factors for severe PPH in women without prenatally suspected PAS, although that is precisely the relevant clinical question necessary to stratify the level of risk of severe PPH and adapt maternal care to it.

As expected, unsuspected PAS was a major risk factor. This finding underlines the need to improve radiologic tools to characterize PAS before birth (33,34). However, as it is likely that the proportion of women with PAS screened antenatally will never reach 100%, our results contribute to the debate about whether these women should deliver in a center equipped to deal with PAS discovered at the time of delivery.

Our study showed that the previa location of the placenta was associated with a doubled risk of severe PPH compared with low-lying placenta. Other center-based studies have estimated the risk of severe PPH according to placental location without a specific focus on women with a previous cesarean (16,36). They showed higher risks of severe PPH in cases of anterior compared with posterior locations but did not investigate this risk according to the distance of the placenta from the cervical internal os. In our study, although some posterior previa

placentas may not cover the cesarean scar, we did not differentiate posterior or anterior previa placenta because caesarean scar is mostly found in the cervix or very close to the internal os (41).

Our study suggests that all women with an anterior-low-lying or previa placenta and prior cesarean with PAS not prenatally suspected should give birth in hospitals with resources appropriate to manage severe PPH and unexpected PAS. The precise knowledge of the placental location may improve the physician's assessment of the risk of severe bleeding. US guidelines recommend birth in a specialized care (level III for Maternal Care) unit for women at high risk of postpartum hemorrhage (including all women with placenta previa), and UK guidelines suggest birth in a hospital with a blood bank for all women with placenta previa, whereas in Canada and France the place of delivery is left to the obstetrician's decision (10–12,42). However, none of these recommendations mention women with a low-lying placenta. Our findings provide further evidence of the need to update those guidelines, which could usefully also include women with anterior low-lying placentas.

Conclusion

We showed that even when PAS is not suspected before birth, women with an anterior-low-lying or previa placenta and prior cesarean have a high risk of severe PPH, especially when the placenta is previa compared with low-lying. These deliveries should be performed in settings with the appropriate resources.

267 **Tables and figure legends:**

268 **Figure 1:** Flow chart of the study population

269 **Table 1:** Characteristics of women and severe postpartum hemorrhage rates according to these
 270 characteristics, overall (study population 1) and after exclusion of women with PAS diagnosed
 271 only at birth (study population 2).

272 PPH: postpartum hemorrhage; PAS: placenta accreta spectrum; IQR: interquartile range; BMI:
 273 body mass index; IVF: in vitro fertilization; PPROM: preterm premature rupture of membrane;
 274 CD: cesarean delivery; PAS: placenta accreta spectrum

275 a: severe PPH: defined by a composite criterion of one or more of the following: PPH with
 276 estimated blood loss of 1500 ml or more and/or requiring transfusion of 4 or more units of
 277 packed red blood cells and/or embolization and/or uterine-sparing surgical treatment and/or
 278 hysterectomy.

279 b: For study population 1 and 2, the first column presents the characteristics of the population,
 280 i.e. the column % of each sub-group within the total population (N=230 for study population 1,
 281 N=208 for study population 2). In the second column we present the rate of severe PPH within
 282 each subgroup; row % with the number of women in each subgroup as denominator.

283 c: include prior curettage and other uterine surgery by hysteroscopy (synechia removal,
 284 myomectomy); prior cesarean excluded.

285 d: one woman with a PAS diagnosed at birth with no suspicion of PAS had a PPH but not
 286 meeting the criteria for severe PPH (blood loss between 500 and 1000 ml). During the cesarean,

287 a part of the placenta could not be removed leading to the diagnosis of PAS; she received
 288 conservative treatment.

289 *: $.10 < P < .05$; for the test of the difference in PPH rates between categories of the variable

290 **: $P < .05$; for the test of the difference in PPH rates between categories of the variable

291 **Table 2:** Maternal outcomes overall (study population 1) and after exclusion of women with
 292 PAS diagnosed only at birth (study population 2)

293 PPH: postpartum hemorrhage; ICU: intensive care unit; FFP: fresh frozen plasma.

294 a: severe PPH: defined by a composite criterion of one or more of the following: PPH with
 295 estimated blood loss of 1500 ml or more and/or requiring transfusion of 4 or more units of
 296 packed red blood cells and/or embolization and/or uterine-sparing surgical treatment and/or
 297 hysterectomy.

298 b: Uterine-sparing surgical treatment was defined by uterine compression sutures, or surgical
 299 ligation of uterine or other pelvic arteries

300 **Table 3:** Risk factors for severe postpartum hemorrhage in the study population 1 (overall) and
 301 after exclusion of women with PAS diagnosed at birth (study population 2): univariate and
 302 multivariate analysis.

303 PAS: placenta accreta spectrum; BMI: body mass index; OR: odds ratio; aOR: adjusted odds
 304 ratio

305 a: multivariate logistic regression model with multiple imputation including variables listed in
 306 the column

307 b: include prior curettage and other uterine surgery by hysteroscopy (synechia removal,
308 myomectomy); prior cesarean excluded

309

310 **Table S1:** Investigations and maternal outcomes in women with PAS diagnosed at birth and not
311 prenatally suspected

312 PPH: postpartum hemorrhage; ICU: intensive care unit; FFP: fresh frozen plasma

313 a: severe PPH: defined by a composite criterion of one or more of the following: PPH with
314 estimated blood loss of 1500 ml or more and/or requiring transfusion of 4 or more units of red
315 blood cells and/or embolization and/or uterine-sparing surgical treatment and/or
316 hysterectomy.

317 b: one woman with a PAS diagnosed at birth but not prenatally suspected had a PPH that did
318 not meet the criteria for severe PPH (blood loss between 500 and 1000 ml). During the
319 cesarean, a part of placenta could not be removed, leading to the diagnosis of PAS. She
320 received conservative treatment.

321 c: Uterine-sparing surgical treatment was defined as uterine compression sutures, or surgical
322 ligation of uterine or other pelvic arteries

323 **Declaration section**

324 **Author contributions:**

325 Anne Pinton made statistical analysis and interpretation of data and drafted the work and made
326 the correction of the manuscript and approved the final version to be published and agreed to
327 be accountable for all aspects of the works. Aurélien Seco made substantial contributions to the
328 acquisition of data for the work and revising it critically and approved the final version to be
329 published and agreed to be accountable for all aspects of the works. Gilles Kayem and
330 Catherine Deneux made contributions to the conception and design of the work and revised it
331 critically and approved the final version to be published and agreed to be accountable for all
332 aspects of the works. Loïc Sentilhes made substantial contributions to the interpretation of data
333 for the work and revised it critically for important intellectual content and approved the final
334 version to be published and agreed to be accountable for all aspects of the works.

335 **Funding statements:**

336 PACCRETA was funded by the French Health Ministry under its Clinical Research Hospital
337 Program (grant number: AOR12156) and by the Angers University Hospital. The funders had no
338 role in the study design, data collection and analysis, decision to publish, or preparation of the
339 manuscript.

340 **Acknowledgments:**

341 The authors thank the women who participated in the study. The authors thank the URC-CIC
342 Paris Descartes Necker/Cochin AP-HP (Laurence Lecomte) for the study implementation,

monitoring, and data management; the coordinators of the participating regional perinatal networks for their help in the implementation and coordination of the PACCRETA Study in their region: Alsace, Aurore, Auvergne, Basse-Normandie, Centre, Lorraine, MYPA, NEF, Paris Nord, Pays de Loire, 92 Nord; Isabelle AVRIL, Sophie Bazire, Sophie Bedel, Fanny De Marcillac, Laurent Gaucher, Maëlle Guitton, Catherine Guerin, Laurence Lecomte, Marine Pranal, Laetitia Rault, Anne Viallon, Myriam Virilouvet and Justine Schwanka, for their contribution to inclusion and data collection; the obstetricians, midwives, and anesthetists who contributed to case identification and documentation in their hospitals; and the research assistants who collected the data.

The authors thank Jo Ann Cahn for her help in editing this manuscript.

Disclosure of Interests:

Dr. Sentilhes reports receiving lecture and consulting fees from Ferring, and lecture fees from Bayer, GSK and SIGVARIS. No other potential conflict of interest relevant to this article was reported.

Ethical statement

The appropriate ethics committees (Consultative Committee on the Treatment of Data on Personal Health for Research Purposes - reference n° AOR12156, and the Committee for the Protection of People Participating in Biomedical Research - reference CPP 13-017) and the National Data Protection Authority (CNIL n° DR-2013-427) approved this study in 2012.

References:

1. Boerma T, Ronsmans C, Melesse DY, Barros AJD, Barros FC, Juan L, et al. Global epidemiology of use of and disparities in caesarean sections. *Lancet Lond Engl*. 13 oct 2018;392(10155):1341- 8.
2. OECD. Caesarean sections [Internet]. Paris: Organisation for Economic Co-operation and Development; 2018 [cité 3 nov 2021]. Disponible sur: https://www.oecd-ilibrary.org/fr/social-issues-migration-health/caesarean-sections/indicator/english_adc3c39f-en
3. Betrán AP, Ye J, Moller AB, Zhang J, Gülmezoglu AM, Torloni MR. The Increasing Trend in Caesarean Section Rates: Global, Regional and National Estimates: 1990-2014. *PloS One*. 2016;11(2):e0148343.
4. Keag OE, Norman JE, Stock SJ. Long-term risks and benefits associated with cesarean delivery for mother, baby, and subsequent pregnancies: Systematic review and meta-analysis. *PLoS Med*. janv 2018;15(1):e1002494.
5. Kayem G, Seco A, Beucher G, Dupont C, Branger B, Crenn Hebert C, et al. Clinical Profiles of Placenta Accreta Spectrum: the PACCRETA Population-Based Study. *BJOG Int J Obstet Gynaecol*. 3 janv 2021;
6. Fitzpatrick KE, Sellers S, Spark P, Kurinczuk JJ, Brocklehurst P, Knight M. The management and outcomes of placenta accreta, increta, and percreta in the UK: a population-based descriptive study. *BJOG Int J Obstet Gynaecol*. janv 2014;121(1):62- 70; discussion 70-71.
7. Jauniaux E, Bunce C, Grønbeck L, Langhoff-Roos J. Prevalence and main outcomes of placenta accreta spectrum: a systematic review and meta-analysis. *Am J Obstet Gynecol*. sept 2019;221(3):208- 18.
8. Jauniaux ERM, Alfirevic Z, Bhide AG, Belfort MA, Burton GJ, Collins SL, et al. Placenta Praevia and Placenta Accreta: Diagnosis and Management. *BJOG Int J Obstet Gynaecol*. 2019;126(1):e1- 48.
9. Collins SL, Alemdar B, van Beekhuizen HJ, Bertholdt C, Braun T, Calda P, et al. Evidence-based guidelines for the management of abnormally invasive placenta: recommendations from the International Society for Abnormally Invasive Placenta. *Am J Obstet Gynecol*. juin 2019;220(6):511- 26.
10. Goffinet F, Mercier F, Teyssier V, Pierre F, Dreyfus M, Mignon A, et al. [Postpartum haemorrhage: recommendations for clinical practice by the CNGOF (December 2004)]. *Gynecol Obstet Fertil*. avr 2005;33(4):268- 74.
11. Jain V, Bos H, Bujold E. Guideline No. 402: Diagnosis and Management of Placenta Previa. *J Obstet Gynaecol Can*. 1 juill 2020;42(7):906-917.e1.

- 397 12. Placenta Praevia and Placenta Accreta: Diagnosis and Management (Green-top Guideline
398 No. 27a) [Internet]. Royal College of Obstetricians & Gynaecologists. [cité 14 janv
399 2021]. Disponible sur: [https://www.rcog.org.uk/en/guidelines-research-](https://www.rcog.org.uk/en/guidelines-research-services/guidelines/gtg27a/)
400 [services/guidelines/gtg27a/](https://www.rcog.org.uk/en/guidelines-research-services/guidelines/gtg27a/)
- 401 13. Committee on Practice Bulletins-Obstetrics. Practice Bulletin No. 183: Postpartum
402 Hemorrhage. *Obstet Gynecol.* oct 2017;130(4):e168- 86.
- 403 14. Fan D, Xia Q, Liu L, Wu S, Tian G, Wang W, et al. The Incidence of Postpartum Hemorrhage
404 in Pregnant Women with Placenta Previa: A Systematic Review and Meta-Analysis. *PloS*
405 *One.* 2017;12(1):e0170194.
- 406 15. Kim JW, Lee YK, Chin JH, Kim SO, Lee MY, Won HS, et al. Development of a scoring system
407 to predict massive postpartum transfusion in placenta previa totalis. *J Anesth.* août
408 2017;31(4):593- 600.
- 409 16. Jing L, Wei G, Mengfan S, Yanyan H. Effect of site of placentation on pregnancy outcomes in
410 patients with placenta previa. *PloS One.* 2018;13(7):e0200252.
- 411 17. Crane JM, Van den Hof MC, Dodds L, Armson BA, Liston R. Maternal complications with
412 placenta previa. *Am J Perinatol.* 2000;17(2):101- 5.
- 413 18. Olive EC, Roberts CL, Algert CS, Morris JM. Placenta praevia: maternal morbidity and place
414 of birth. *Aust N Z J Obstet Gynaecol.* déc 2005;45(6):499- 504.
- 415 19. Grobman WA, Gersnoviez R, Landon MB, Spong CY, Leveno KJ, Rouse DJ, et al. Pregnancy
416 outcomes for women with placenta previa in relation to the number of prior cesarean
417 deliveries. *Obstet Gynecol.* déc 2007;110(6):1249- 55.
- 418 20. Belachew J, Eurenus K, Mulic-Lutvica A, Axelsson O. Placental location, postpartum
419 hemorrhage and retained placenta in women with a previous cesarean section delivery: a
420 prospective cohort study. *Ups J Med Sci.* août 2017;122(3):185- 9.
- 421 21. Liang-Kun M, Na N, Jian-Qiu Y, Xu-Ming B, Jun-Tao L. Clinical analysis of placenta previa
422 complicated with previous caesarean section. *Chin Med Sci J Chung-Kuo Hsueh Ko Hsueh*
423 *Tsa Chih.* sept 2012;27(3):129- 33.
- 424 22. Narava S, Pokhriyal SC, Singh SB, Barpanda S, Bricker L. Outcome of multiple cesarean
425 sections in a tertiary maternity hospital in the United Arab Emirates: A retrospective
426 analysis. *Eur J Obstet Gynecol Reprod Biol.* avr 2020;247:143- 8.
- 427 23. Gibbins KJ, Einerson BD, Varner MW, Silver RM. Placenta previa and maternal hemorrhagic
428 morbidity. *J Matern-Fetal Neonatal Med Off J Eur Assoc Perinat Med Fed Asia Ocean*
429 *Perinat Soc Int Soc Perinat Obstet.* févr 2018;31(4):494- 9.

- 430 24. Kayem G, Deneux-Tharaux C, Sentilhes L, PACCRETA group. PACCRETA: clinical situations at
431 high risk of placenta ACCRETA/percreta: impact of diagnostic methods and management on
432 maternal morbidity. *Acta Obstet Gynecol Scand.* avr 2013;92(4):476- 82.
- 433 25. Guy GP, Peisner DB, Timor-Tritsch IE. Ultrasonographic evaluation of uteroplacental blood
434 flow patterns of abnormally located and adherent placentas. *Am J Obstet Gynecol.* sept
435 1990;163(3):723- 7.
- 436 26. Finberg HJ, Williams JW. Placenta accreta: prospective sonographic diagnosis in patients
437 with placenta previa and prior cesarean section. *J Ultrasound Med Off J Am Inst Ultrasound*
438 *Med.* juill 1992;11(7):333- 43.
- 439 27. Kamel R, Eissa T, Sharaf M, Negm S, Thilaganathan B. Position and integrity of uterine scar
440 are determined by degree of cervical dilatation at time of Cesarean section. *Ultrasound*
441 *Obstet Gynecol Off J Int Soc Ultrasound Obstet Gynecol.* mars 2021;57(3):466- 70.
- 442 28. Deleu F, Deneux-Tharaux C, Chiesa-Dubruille C, Seco A, Bonnet MP, EPIMOMS study group
443 (see Appendix). A population-based analysis of French transfusion practices for women
444 experiencing severe postpartum hemorrhage. *Int J Obstet Anesth.* mai 2020;42:11- 9.
- 445 29. Sathe NA, Likis FE, Young JL, Morgans A, Carlson-Bremer D, Andrews J. Procedures and
446 Uterine-Sparing Surgeries for Managing Postpartum Hemorrhage: A Systematic Review.
447 *Obstet Gynecol Surv.* févr 2016;71(2):99- 113.
- 448 30. White IR, Royston P, Wood AM. Multiple imputation using chained equations: Issues and
449 guidance for practice. *Stat Med.* 20 févr 2011;30(4):377- 99.
- 450 31. Shamshirsaz AA, Fox KA, Erfani H, Belfort MA. The Role of Centers of Excellence With
451 Multidisciplinary Teams in the Management of Abnormal Invasive Placenta. *Clin Obstet*
452 *Gynecol.* déc 2018;61(4):841- 50.
- 453 32. Silver RM, Fox KA, Barton JR, Abuhamad AZ, Simhan H, Huls CK, et al. Center of excellence
454 for placenta accreta. *Am J Obstet Gynecol.* mai 2015;212(5):561- 8.
- 455 33. Jauniaux E, Kingdom JC, Silver RM. A comparison of recent guidelines in the diagnosis and
456 management of placenta accreta spectrum disorders. *Best Pract Res Clin Obstet Gynaecol.*
457 avr 2021;72:102- 16.
- 458 34. Jauniaux E, Grønbeck L, Bunce C, Langhoff-Roos J, Collins SL. Epidemiology of placenta
459 previa accreta: a systematic review and meta-analysis. *BMJ Open.* 12 nov
460 2019;9(11):e031193.
- 461 35. Zlatnik MG, Cheng YW, Norton ME, Thiet MP, Caughey AB. Placenta previa and the risk of
462 preterm delivery. *J Matern-Fetal Neonatal Med Off J Eur Assoc Perinat Med Fed Asia Ocean*
463 *Perinat Soc Int Soc Perinat Obstet.* oct 2007;20(10):719- 23.

- 464 36. Baba Y, Matsubara S, Ohkuchi A, Usui R, Kuwata T, Suzuki H, et al. Anterior placentation as a
465 risk factor for massive hemorrhage during cesarean section in patients with placenta previa.
466 J Obstet Gynaecol Res. mai 2014;40(5):1243- 8.
- 467 37. Wortman AC, Twickler DM, McIntire DD, Dashe JS. Bleeding complications in pregnancies
468 with low-lying placenta. J Matern-Fetal Neonatal Med Off J Eur Assoc Perinat Med Fed Asia
469 Ocean Perinat Soc Int Soc Perinat Obstet. 2016;29(9):1367- 71.
- 470 38. Osmundson SS, Wong AE, Gerber SE. Second-trimester placental location and postpartum
471 hemorrhage. J Ultrasound Med Off J Am Inst Ultrasound Med. avr 2013;32(4):631- 6.
- 472 39. Tuzovic L. Complete versus incomplete placenta previa and obstetric outcome. Int J
473 Gynaecol Obstet Off Organ Int Fed Gynaecol Obstet. mai 2006;93(2):110- 7.
- 474 40. Ge J, Liao H, Duan L, Wei Q, Zeng W. Uterine packing during cesarean section in the
475 management of intractable hemorrhage in central placenta previa. Arch Gynecol Obstet.
476 févr 2012;285(2):285- 9.
- 477 41. Zimmer EZ, Bardin R, Tamir A, Bronshtein M. Sonographic imaging of cervical scars after
478 Cesarean section. Ultrasound Obstet Gynecol Off J Int Soc Ultrasound Obstet Gynecol. juin
479 2004;23(6):594- 8.
- 480 42. Levels of Maternal Care. Available on: [https://www.acog.org/en/clinical/clinical-](https://www.acog.org/en/clinical/clinical-guidance/obstetric-care-consensus/articles/2019/08/levels-of-maternal-care)
481 [guidance/obstetric-care-consensus/articles/2019/08/levels-of-maternal-care](https://www.acog.org/en/clinical/clinical-guidance/obstetric-care-consensus/articles/2019/08/levels-of-maternal-care)
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