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Maternal consequences of caesarean section
A retrospective study of intra-operative and postoperative maternal complications of caesarean section during a 10-year period

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Abstract

Objectives: This study was performed to assess the intra-operative surgical complications and postoperative maternal morbidity rate of caesarean section. *Study design:* A total of 2647 women, delivered by caesarean section in our department between 1983 and 1992, were studied retrospectively. Three caesarean section groups were formed: (1) primary elective, (2) primary acute, without any effort to deliver vaginally, and (3) secondary acute, due to a failed vaginal delivery. The Student's-*t*-, Fisher-exact- and X^2-test were used for statistical analysis. *Rusults:* The overall maternal *intra-operative* complication rate was 14.8%. The most common complications were lacerations of the uterine corpus (10.1%) and bloodloss ≥1000 ml (7.3%). The complication rate of the secondary group (23.4%) was significantly higher ($p<0.001$) compared to both primary groups (7.4%). The overall maternal *postoperative* morbidity rate was 35.7%. Fever (24.6%), bloodloss between 1000 and 1500 ml (4%), haematoma (3.5%) and urinary tract infections (3.0%) were the most frequent complications. The primary elective group showed significantly ($p<0.001$) lower major (2.6%) and minor (23.7%) complication rates compared to the emergency groups (major 5.2%, minor 34%). *Conclusion:* Emergency caesarean sections carried the greatest risks regarding maternal complications compared to elective procedures. © 1997 Elsevier Science Ireland Ltd.

Keywords: Elective; Emergency; Primary and secondary caesarean sections; Intra-operative and postoperative maternal complications

1. Introduction

In many countries there has been a dramatic rise in the caesarean section (CS) rate over the past 50 years [1]. The increase of this rate in the Netherlands was twelve fold between 1938 and 1983 [2]; in our department it rose seven and half fold from 3.3% in 1967 to 25% in 1995 [3].

Nowadays, CS is considered to be a safe operation to circumvent maternal and fetal complications. However, maternal mortality after CS was nearly 100% till 1850. The uterine incision was left open because it was thought to be superfluous or even dangerous. The principal causes of maternal deaths were infections and bleedings. The turning point in the development of technique in CS was closing the uterine incision with silver wires by Max Sänger in 1882. The maternal mortality decreased to 50%. Other important developments in preventing maternal death due to CS was the introduction of anaesthesia by Jackson and Morton in 1846 in Boston, the technique of asepsis by Ignace Semmelweis in 1861 in Vienna and the antisepsis by Lord Lister in 1876 in Edinburgh [4].

Notwithstanding these new evolutions, the high incidence of infection and especially peritonitis after caesarean section was the major cause of maternal mortality. To overcome this problem, in 1875 Edoardo Porro from Pavia amputated the uterus supracervically after caesarean section and secured the stump in the abdominal wall. Using this procedure, the maternal mortality decreased to 15%.

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Maternal mortality continued to fall during the early years of the 20th century to at least 10% as extraperitoneal techniques were devised to prevent peritoneal infections. In the Netherlands, a mortality rate after CS of 4% was registered in 1910 [2].

The introduction of both penicillin and blood transfusion during the Second World War lowered again the maternal mortality and morbidity after abdominal delivery. Fetal monitoring and modern obstetric surgery with its aseptic technique, the possibility of blood transfusions and the use of antibiotics may explain the increase of CS. In spite of improved peri-operative conditions the maternal mortality and morbidity rates are still a major concern for many obstetricians. The occurrence of complications may depend on whether any effort has been made to deliver vaginally. The aim of this study was to assess the differences in maternal complication rates between primary and secondary caesarean sections.

2. Material and methods

All CS performed between 1983 and 1992 in our department of Obstetrics and Gynaecology were studied retrospectively. Three groups were formed (Table 1):

(1) Primary Elective CS (PE) was defined as a planned operation in which the patient had been admitted to our hospital at least 8 h before the caesarean section without symptoms of ruptured membranes, regular uterine contractions or vaginal bleeding.

(2) Primary Acute CS (PA) was defined as an operation in which the period between the decision to deliver the baby abdominally and the actual performance took less than 8 h, ignoring the stage of labour, without any attempt to deliver vaginally.

(3) Secondary Acute CS (SA) was defined as a caesarean section following a failed vaginal delivery.

2.1. Indications

Indications of CS (Table 2) were divided in six groups: disproportion between the fetus and the maternal pelvis, obstructed labour, fetal distress (diagnosed by cardiotocography registration or by fetal scalp blood sample), placental abruption and repeat caesarean section (defined as a CS because of a previous CS). Hypertensive disorders, placenta praevia, fetal abnormalities etc. are described in one group ('others').

2.2. Complications

Intra-operative complications included *maternal* (lesions of bladder, uterus, cervix/vagina, aa. uterinae/ligamentum latum/bowels; bloodloss ≥1000 ml) and *fetal* complications. Anaesthesiological difficulties were omitted (Table 4).

Postoperative maternal complications were divided into *major* and *minor* complications while fetal complications were excluded.

Major postoperative complications (Table 5) included bloodloss ≥1500 ml, relaparotomy, pelvic infection, pneumonia, thrombosis/embolism, sepsis and disseminated intravascular coagulation disorders. Pelvic infection was defined as uterine tenderness, positive lochia culture and fever. If a patient had clinical symptoms of pulmonary infection while the X-ray showed an infiltration, she was classified as having a pneumonia. Thrombosis was diagnosed in case of a swollen and painful leg, crossing curves of raised temperature and pulse-rate, and confirmation by Doppler-test. Lung embolism was confirmed by ventilation/perfusion scan. A patient was said to have a sepsis if there were symptoms of fever, rigors and signs of shock with a positive bloodculture.

Minor postoperative complications (Table 6) included bloodloss between 1000 and 1500 ml, fever, endometritis (ample, foul smelling lochia without uterine tenderness), abdominal wall infection/haematoma which could be treated conservatively, thrombophlebitis, urinary tract infection confirmed by a positive culture, symptoms of ileus which could be treated conservatively, bladder paralysis which necessitated catheterisation and fever. Fever was defined as a body temperature of ≥38°C measured on at least two different occasions with an interval of at least 24 h or a peak of body temperature ≥39.5°C during the 10-day-period after delivery with exclusion of the first 24 h.

Student's *t*-test, Fisher-exact-test and X^2-test were used for statistical analysis where appropriate. Differences were considered significant if p was at least <0.05.

3. Results

Between 1983 and 1992, a total of 2758 CS were performed in our department. The PE, PA and SA caesarean sections rates are shown in Fig. 1. The primary elective CS rate increased from 16% in 1983 to 29% in 1992.

3.1. Obstetrics characteristics

Because of a lack of data, 111 (4%) patients were excluded. The remaining 2647 CS were analysed. The epidemiological and obstetrical parameters are described in Table 1. Mean maternal age, mean parity and experience of the surgeon are equally distributed among the three groups. Primary acute CS were performed six times more in the pre-term groups than secondary acute CS ($p<0.001$). However, if the gestational age was >37 weeks, then the elective and the secondary acute CS were performed 3 times more often than primary acute CS ($p<0.01$). Ruptured membranes existing less than 12 h and

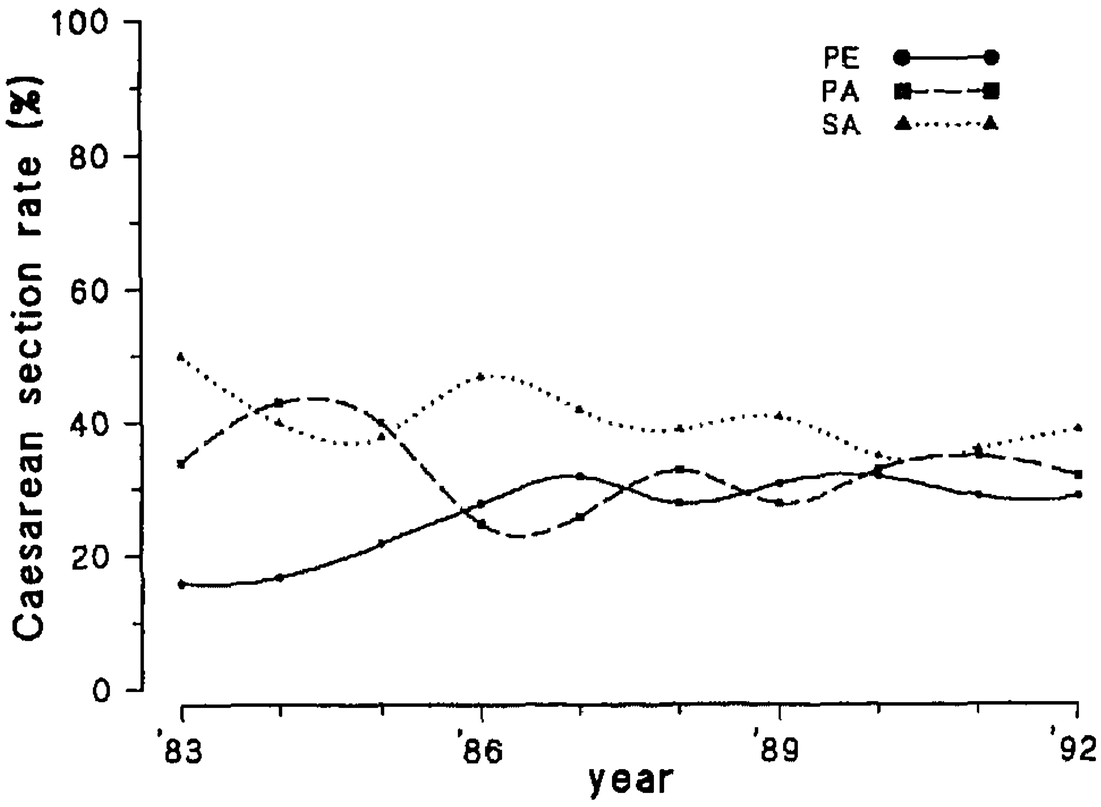

Fig. 1. Distribution of the Caesarean section rate (%) from 1983–1992 at the University Hospital Nijmegen, The Netherlands, according to primary elective (PE), primary acute (PA) and secondary acute (SA) caesarean sections.

existing 12 to 24 h occurred more often in the SA group compared to the PA group ($p<0.001$; Table 1). However, no statistical difference between these two groups was observed when the period of ruptured membranes exceeded 24 h.

3.2. Indications of caesarean sections

The majority of all CS (55.2)% were performed because of disproportion between the fetus and the maternal pelvis, obstructed labour and fetal distress (Table 2). Repeat CS (defined as a CS performed because a previous CS) was carried out in 8.9% only and was significantly ($p<0.001$) more performed in the elective group. Disproportion was observed more frequently in the elective group (42.2%) than in the PA group (8.1%; $p<0.001$) and SA group (18.7%; $p<0.001$). Fetal distress caused 260 primary acute CS (30.3%) compared to 178 secondary acute CS

Table 1
Epidemiological and obstetrical characteristics of caesarean sections ($n=2647$) performed between 1983 and 1992 at the University Hospital Nijmegen according to primary elective (PE), primary acute (PA) and secondary acute (SA) caesarean sections (CS)

	PE	PA	SA
	718 *(27.1%)*	859 *(32.5%)*	1070 *(40.4%)*
Maternal age *(yr)*			
Mean *(range)*	30.5 *(18--43)*	28.9 *(16--49)*	29.3 *(17--47)*
Parity			
Mean *(range)*	1.0 *(0–9)*	0.7 *(0–11)*	0.4 *(0–6)*
Gestational age *(%)*			
<28 weeks	5 *(0.7)*	51 *(5.9)*[a]	10 *(0.9)*
28–37 weeks	95 *(13.2)*	562 *(65.4)*[a]	115 *(10.7)*
>37 weeks	618 *(86.1)*	246 *(28.7)*[a]	945 *(88.4)*
Ruptured membranes *(%)*		135 *(15.7)*	889 *(93.0)*
<12 h	–	63 *(7.3)*[a]	542 *(50.6)*
12–24 h	–	26 *(3.0)*[a]	261 *(24.4)*
>24 h	–	46 *(5.4)*	86 *(8)*
Surgeon *(%)*			
resident	464 *(65)*	518 *(60)*	654 *(61)*
obstetrician	254 *(35)*	341 *(40)*	416 *(39)*

[a] $p<0.001$ (see text).

Table 2
Indications for caesarean sections performed between 1983–1992 in the University Hospital Nijmegen assigned to primary elective (PE), primary acute (PA) and secondary acute (SA) groups

Indications	PE	PA	SA	Total
	718 *(27.1)*	859 *(32.5)*	1070 *(40.4)*	2647
Disproportion	303 *(42.2)*[a]	70 *(8.1)*	200 *(18.7)*	573 *(21.6)*
Obstructed labour	–	–	453 *(42.3)*	453 *(17.1)*
Fetal distress	–	260 *(30.3)*[a]	178 *(16.6)*	438 *(16.5)*
Abruption placentae	–	98 *(11.4)*	13 *(1.2)*	111 *(4.2)*
Repeat caesarean section	64 *(8.9)*[a]	23 *(2.5)*	15 *(1.4)*	102 *(3.9)*
Others	351 *(48.9)*	408 *(47.6)*	211 *(19.8)*	970 *(36.6)*

Percentages between brackets.
[a] $p<0.001$ (see text).

Table 3
Number of patients with intra-operative and postoperative complications. Caesarean sections (CS) performed between 1983–1992 in the University Hospital Nijmegen assigned to primary elective (PE), primary acute (PA) and secondary acute (SA) groups

	PE	PA	Primary CS (PE&PA)	Secondary CS (SA)	Emergency CS (PA&SA)	Total
	718 *(27.1)*	859 *(32.5)*	1577 *(59.6)*	1070 *(40.4)*	1929 *(72.9)*	2647
Intra-operative complications	65 *(9.1)*[a]	77 *(9.0)*	142 *(7.4)*[b]	250 *(23.4)*[b]	327 *(17.0)*[a]	392 *(14.8)*
Postoperative complications	189 *(26.3)*[a]	311 *(36.2)*	500 *(31.7)*	446 *(41.7)*	757 *(39.2)*[a]	946 *(35.7)*
Major	19 *(2.6)*[a]	55 *(6.4)*	74 *(4.7)*	46 *(4.3)*	101 *(5.2)*[a]	120 *(4.5)*
Minor	170 *(23.7)*[a]	256 *(29.8)*	426 *(27.0)*	400 *(37.4)*	656 *(34.0)*[a]	826 *(31.2)*

Percentages between brackets.
[a] p <0.001 [Elective (PE) vs emergency CS (PA and SA)].
[b] p <0.001 [Primary (PE and PA) vs secondary CS (SA)].

(16.6%; p<0.001). According to the definitions, obstructed labour occurred only in the SA group. Due to the heterogeneity of the group 'others', no statistical analysis was carried out.

3.3. Intra-operative complications

A total number of 392 patients (14.8%) endured intra-operative complications (Table 3). The most frequent *fetal* complication was an accidental incision of the fetal skin while opening the uterus (1.3%). Lacerations of the uterine corpus (10.1%) and bloodloss ≥1000 ml (7.3%)were the most common *maternal* problems (Table 4).

The overall intra-operative complication rate of the secondary group (23.4%) was significantly higher (p< 0.001) than both primary groups (7.4%) (Table 3). The primary groups (PE and PA) showed significantly (p< 0.001) less lacerations of the uterine corpus compared to the secondary CS (16.5%). Bloodloss ≥1000 ml was significantly (p<0.001) less observed in the elective group (4.7%) compared to the acute procedures (PA and SA) (8.3%; Table 4). No hysterectomies during CS were performed.

3.4. Postoperative complications

A total number of 946 patients (35.7%) endured postoperative complications (Table 3). *Major* complications were observed in 120 patients (4.5%). Bloodloss exceeding 1500 ml, relaparotomy, pelvic infection and thrombosis/embolism were the most common major problems (Table 5). Relaparotomy was mainly performed for reasons of subfascial and subcutaneous bleedings. The elective group showed a significant (p<0.001) lower number of patients with major complications (2.6%) compared to both acute groups (Table 3).

Minor complications were observed in 826 patients (31.2%) (Table 3). Fever, bloodloss between 1000 and 1500 ml, haematoma and urinary tract infection turned out to be the most frequent *minor* complications (Table 6). The elective group showed a significantly (p<0.001) lower number of patients with minor complications (23.7%) compared to the acute groups (34.0%; Table 3). Fever was observed significantly (p<0.001) less frequent in the elective group (15.7%) than in both acute groups (27.9%; Table 6).

Patients in labour showed significantly more (p<0.001) postoperative complications (39.2%) compared to patients without regular uterine contractions (26.3%) (Table 3).

If the membranes were intact the postoperative complication rate was 34.1%. The complication rate increased as the period of ruptured membranes got longer (<12 h= 43.4%, 12–24 h=40.7%, >24 h=50.8%).

Neither the way of opening the abdomen (Joel Cohen,

Table 4
Distribution of *intra-operative* maternal and fetal complications of caesarean sections (n=2647) performed between 1983–1992 in the University Hospital Nijmegen assigned to primary elective (PE; n=718), primary acute (PA; n=859) and secondary acute (SA; n=1070) caesarean sections

Complications	PE	PA	SA	Total
	105	154	330	589
Uterine corpus laceration	43 *(6.0)*	47 *(5.5)*	176 *(16.5)*[a]	226 *(10.1)*
Bloodloss ≥1000 ml	34 *(4.7)*[a]	67 *(7.8)*	93 *(8.7)*	194 *(7.3)*
Fetal complications	6 *(0.8)*	12 *(1.4)*	16 *(1.5)*	34 *(1.3)*
Bladder lesion	9 *(1.3)*	3 *(0.4)*	10 *(0.9)*	22 *(0.8)*
Lesion of Aa. uterinae/lig.latum/bowels	3 *(0.4)*	5 *(0.6)*	6 *(0.6)*	14 *(0.5)*
Cervical/vaginal lesions	–	2 *(0.2)*	6 *(0.6)*	8 *(0.3)*
Others	10 *(1.4)*	18 *(2.1)*	23 *(2.2)*	51 *(1.9)*

Note that number of complications (n=589) exceeds number of patients because patients can have more than one complication (n=392; Table 3). The category 'others' includes lesions of muscles, suturing of the uterine posterior to anterior wall etc.
[a] p<0.001.
Percentages between brackets.

Table 5
Distribution of *postoperative* maternal *major* complications in 2647 caesarean sections performed between 1983–1992 in the University Hospital Nijmegen assigned to primary elective (PE; $n=718$), primary acute (PA; $n=859$) and secondary acute (SA; $n=1070$) caesarean sections

Complications	PE	PA	SA	Total
	26	79	56	161
Bloodloss ≥1500 ml	11 *(1.5)*	25 *(2.9)*	28 *(2.6)*	64 *(2.4)*
Relaparotomy	6 *(0.8)*	29 *(3.4)*	8 *(0.8)*	43 *(1.6)*
Pelvic infection	4 *(0.6)*	1 *(0.1)*	11 *(1.0)*	16 *(1.5)*
Thrombosis	4 *(0.6)*	9 *(1.0)*	3 *(0.3)*	16 *(1.5)*
Pneumonia	–	5 *(0.6)*	4 *(0.4)*	9 *(0.3)*
Sepsis	–	5 *(0.6)*	2 *(0.2)*	7 *(0.3)*
Coagulation disorders	–	1 *(0.1)*	–	1 *(0.1)*
Others	1 *(0.2)*	4 *(0.5)*	–	5 *(0.2)*

Note that number of complications ($n=161$) exceeds number of patients because patients can have more than one complication ($n=120$, Table 3). Percentages between brackets.

Pfannenstiel or midline incision) nor the way of opening the uterus (low segmental, low cervical, classical incision, stapling technique [5]) appeared to be significantly correlated with postoperative complications. If the CS was performed by an obstetrician, the intra-operative complication rate was 13.1% compared to 15.9% in operations performed by residents under supervision ($p=0.046$) (Table 1). The influence of antibiotic prophylaxis on postoperative infections was not analysed because of unreliable data. The mean period of postoperative stay in hospital for the PE group was 7.2±2.4 days (mean, sd), which was not significantly different from the 7.8±3.1 days of the PA group nor from the 7.6±1.9 days of the SA group.

3.5. Maternal deaths

All three maternal deaths after CS were caused by underlying pathology. One patient died because of a cerebral aneurysm and another from subarachnoidal bleeding. The third patient was suffering from cryptogenic cirrhosis. At a gestational age of 26 weeks a severe haemorrhage of oesophageal varices occurred and intrauterine fetal death was diagnosed. A CS was performed in order to create more space for a mesocaval-shunt procedure. 20 h after the operation the patient died because of excessive bloodloss.

Those three deaths are classified as non-obstetric fortuitous maternal deaths [6].

4. Discussion

The CS rate has increased enormously during the last 50 years and it appears that a plateau has not been reached yet. During the studied 10-year-period the CS rate in our department has increased by almost 50% from 1983 to 1992 (14.8% to 20.8%). The increase in the primary elective CS from 16 to 29% together with a decline in the secondary acute CS may be explained by a change in departmental policy since 1983 (Fig. 1).

The most common indications for CS in our study (disproportion, obstructed labour and fetal distress) are similar to those found by others [7]. Scheller et al. [8] described fetal distress as the most frequent indication. Previous CS as an indicator for repeat CS in our study was observed in only 4% of the total number of CS, while in Norway it amounted to 3.6%, in Sweden to 6.6%, in the USA to 10.5% (1990; [9]). The medico-legal climate in the USA is a factor influencing the caesarean section rate [10]. However, as 'trial of labour' after the CS is practised more widely, vaginal births after CS deliveries occur more frequently: in the USA it rose from 3% in 1980 to 20% in 1990, while in the Netherlands, this figure between 1977 and 1987 was 61% [11].

Many publications concerning postoperative maternal

Table 6
Distribution of *postoperative* maternal *minor* complications in 2647 caesarean sections performed between 1983–1992 in the University Hospital Nijmegen, assigned to primary elective (PE; $n=718$), primary acute (PA; $n=859$) and secondary acute (SA; $n=1070$) caesarean sections

Complications	PE	PA	SA	Total
	224	403	569	1196
Fever	113 *(15.7)*[a]	217 *(25.3)*	322 *(30.1)*	652 *(24.6)*
Bloodloss 1000–1500 ml	20 *(2.8)*	32 *(3.7)*	53 *(4.9)*	105 *(4.0)*
Haematoma	19 *(2.6)*	48 *(5.6)*	26 *(2.4)*	93 *(3.5)*
Urinary tract infection	18 *(2.5)*	29 *(3.4)*	33 *(3.1)*	80 *(3.0)*
Thrombophlebitis	8 *(1.1)*	16 *(1.8)*	41 *(3.8)*	65 *(2.5)*
Wound infection	7 *(1.0)*	15 *(1.7)*	30 *(2.8)*	52 *(2.0)*
Ileus	8 *(1.1)*	18 *(1.9)*	14 *(1.2)*	40 *(1.5)*
Endometritis	9 *(1.3)*	4 *(0.5)*	17 *(1.6)*	30 *(1.1)*
Bladder paralysis	8 *(1.1)*	5 *(0.6)*	10 *(1.0)*	23 *(0.9)*
Others	14 *(1.9)*	19 *(2.2)*	23 *(2.1)*	56 *(2.1)*

Note that number of complications ($n=1196$) exceeds number of patients because patients can have more than one complication ($n=826$, Table 3) with complications.
[a] $p<0.001$ (see text).
Percentages between brackets.

morbidity have been published. Intra-operative complications are mainly documented as case-reports. Nielsen et al. [12] observed an overall intra-operative complication rate of 11.6% which is in accordance with 14.8% found in this study. Lacerations from hysterotomy, resulting in profuse bleeding were observed most frequently in both studies.

The published postoperative maternal morbidity rates vary from 14.5% to 33.5% [7,8,12–14] while we observed 35.7%. The most common complications are infections: urinary tract infection, wound infection and endometritis.

Patients in labour and/or ruptured membranes are at risk for complications as was seen in other publications [12–14].

The procedure of elective caesarean section showed significantly less intra- and postoperative complications in comparison with secondary CS (Table 3). All emergency CS were significantly more compromised with more ruptures into the parametrial vein and uterine vessels, and into the cervix leading to excessive blood loss (Table 4). However, when the major postoperative complications were considered, no significant differences were found between the three groups (Table 5). Minor complications were, however, significantly more seen with emphasis on postoperative fever (Table 6).

5. Conclusion

Elective CS gives significantly less intra- and postoperative complications in comparison with emergency CS.

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