

Early complications and late sequelae of induced abortion: a review of the literature

KARIN G. B. EDSTRÖM¹

An attempt to evaluate the recent literature on somatic complications of induced abortion shows that a great amount of data of widely varying quality has been collected. Many areas of research are still not covered in a way that permits valid conclusions to be drawn. Two important points emerge from the review: first, there is a need for uniform definitions of complications and some uniformity in the analysis of data collected; secondly, carefully selected control groups are needed in this kind of research. The areas most urgently requiring further study differ from country to country. From a global point of view, the existence or inexistence of significant late sequelae and the influence of the patient's health status on the complication rate seem to be of the highest priority.

Legislation permitting the performance of abortion on other than strictly medical grounds varies among countries, as does the application of existing laws. The general trend is, however, towards a liberalization of current laws and attitudes. Thus, there is an increased demand on clinical scientists to provide reliable and unbiased data on possible adverse effects of induced abortions—data that are essential for policy makers and health administrators.

This review of the recent literature concerning somatic aspects of induced abortion brings together some of the more valid information concerning the incidence of complications and attempts to evaluate the factors influencing their frequency. It also identifies some of the areas in which further studies and research are required.

There are obvious difficulties in comparing data from different authors; ways of collecting data and definitions of complications differ immensely. The frequent lack of adequate control groups and the sometimes obvious prejudices of the author make it difficult to draw conclusions. The papers reviewed have been selected to cover the various aspects of early complications and late sequelae of abortion as completely as possible and yet to avoid the difficulties mentioned above.

TOTAL MORTALITY AND MORBIDITY RATES

Mortality

Reasonably accurate country statistics are available only for the United Kingdom, USA (New York State), the Scandinavian countries, and some countries in eastern Europe (1–5, 7). Those rates are listed in Table 1. For USA, the only material that is large enough to provide sufficiently reliable data on mortality is that relating to New York State since the new Abortion Act was passed in July 1970 (3). A rate for Japan, based on reported deaths attributed to legal abortion and on reported legal abortions, has been calculated by Tietze (2). The fact that the proportion of unreported abortions in Japan is unknown detracts from the accuracy of calculations for that country, but Tietze's calculated rates for the periods 1950–53 and 1954–58 (8.5 and 5.8 deaths per 100 000 abortions, respectively) correspond rather well to that quoted by Muramatsu (8) from a 1954 survey including 108 055 cases with a mortality of 7.4 per 100 000 abortions. The figures from Korea estimated by Hong (7) are included for comparison, since induced abortion (even outside hospital) is considered to be performed almost exclusively by specialists in obstetrics and gynaecology.

The mortality for different methods has been analysed for 402 000 abortions performed in New York in 1970–72 (3). Uterine aspiration had the lowest rate, 1.1 deaths per 100 000 abortions, dilatation and curettage came next with 2.4, and saline

¹ Research Physician, WHO Research and Training Centre, Karolinska Hospital, Stockholm, Sweden (present address: Medical Officer, Maternal and Child Health, World Health Organization, 1211 Geneva 27, Switzerland).

Table 1. Mortality due to induced abortion in several countries

Country	Period	Mortality per 100 000 abortions	Source of information	Reference No.
Hungary	1964-67	1.2	David, 1970	(1)
Czechoslovakia	1963-67	2.5	David, 1970	(1)
Yugoslavia (Slovenia)	1961-67	5.7	David, 1970	(1)
Japan	1959-65	4.1	Tietze, 1971	(2)
USA (NY)	1970-72	5	Tietze et al., 1973	(3)
United Kingdom (England and Wales)	1970	12	Office of Population Censuses and Surveys, 1973	(4)
Sweden	1965-69	13	National Health Board, 1972	(5)
Korea (Seoul)	1967	60-125 (estimated)	Hong, 1970	(7)

instillation in 53 000 cases had a rate of 18.8. Hysterotomy shows a very high death rate—5 for 2 400 abortions, or 208 per 100 000—but this might be due partly to factors such as health status and age (see below). In the United Kingdom in 1969, the reported mortality for 31 000 uterine aspirations or dilatations and curettages before the 13th week was 6 per 100 000. For 3 700 first-trimester hystero-

tomies it was 80 per 100 000, and for second-trimester hysterotomies 90 deaths per 100 000 abortions (9).

Morbidity

The morbidity rates associated with induced abortions (Table 2) also vary substantially among the different countries (5, 6, 10-19) but not to the same

Table 2. Morbidity rates associated with induced abortion in various countries and with different methods of collecting data

Country	Period	Method of collecting data	Morbidity per 100 abortions	Source of information	Reference No.
USA (NY City residents)	July 1970-March 1971	reports to Department of Health	1.0	Pakter & Nelson, 1971	(10)
USA (Hawaii)	4 months, 1970	reports on 1 169 cases	4.1	Smith et al., 1971	(11)
Czechoslovakia	1963	reports to Department of Health	2.3	Mehlan, 1969	(12)
Hungary (Budapest)	1960-69	reports to Ministry of Health	2.6	Czeizel & Bogнар, 1971	(13)
Denmark	1961-66	reports to Ministry of Health	4.7	Olsen et al., 1971	(6)
United Kingdom (England and Wales)	1969	reports to Ministry of Health	3.4	Huntingford, 1971	(14)
USA (JPSA study)	July 1970-June 1971	survey with follow-up of 73 000 cases	1.0-1.6 ^a 9.6-13.1 ^b	Tietze & Lewit, 1972	(15)
Hungary (Budapest)	1966	survey of 55 000 cases	7.3	Bognar, 1969	(16)
Poland (Warsaw)	1958-68	survey of 3 482 cases	8.4	Sternadel et al., 1968	(17)
Sweden	1964	survey of 1 427 cases	18.5	1965 Committee on Abortion, 1971	(5)
United Kingdom	1967-70	survey of 1 317 National Health Service cases	16.8	Sood, 1971	(18)
Czechoslovakia	1968	"informal estimation by gynaecologists"	15.0	Kuck, 1969	(19)

^a Major complications.

^b Total complications.

Table 3. Early complications occurring in connexion with uterine aspiration and with dilatation and curettage. Number of different complications per 100 abortions

Study	Total complication rate	Bleeding	Infection	Incomplete evacuation	Perforation	Cervical trauma
<i>Uterine aspiration</i>						
range of complication rates ^a in literature reviewed	0.8–7.3	—	0.8–5.0	0.5–10.4	0.03–1.7	0.03–4.9
JPSA (15) {	4.7	1.2	1.5	—	0.3	0.9
total complications			(incl. fever only)			
major complications	0.5					
Vladov et al. (28)	5.2	66 ml ^b	1.6	—	—	—
Jurukovski & Sukarov (23)	3.9	—	1.13	1.82	0.03	0.03
Lunow et al. (26)	—	1.0 ^c	—	—	0.3	0.9
Beric & Kupresanin (21)	—	—	—	1.3	0.4	—
<i>Dilatation and curettage</i>						
range of complication rates ^a in literature reviewed	5.4–15.3	—	0.87–55.6 (5–10) ^d	0.7–3.8	0.12–2.1	0.16–3.9
JPSA (15) {	6.7	—	—	—	—	—
total complications						
major complications	0.6					
Vladov et al. (28)	9.0	85 ml ^b	3.5	—	—	—
Jurukovski & Sukarov (23)	4.8	—	1.65	1.60	0.03	0.16
Lunow et al. (26)	—	2.1 ^c	—	—	2.1	3.9
Beric & Kupresanin (21)	—	—	—	3.8	0.12	—

^a Includes authors under references Nos 6, 15, 18 and 20–29.

^b Mean blood loss (300 cases with uterine aspiration, 280 with dilatation and curettage).

^c Percentage of patients requiring transfusion.

^d Range of most studies reviewed.

extent as mortality rates, and the manner in which data are collected plays a much more important role. Czeizel & Bogнар (13) compare the complication rate in Budapest based on reports to the Office of Statistics during the period 1960–69 with that found in a survey of 55 000 cases in that city during 1966. They find a reported rate of 2.6%, whereas the survey showed that 4.2% were treated in hospital for complications resulting from abortion. Bogнар (16) adds complications registered in outpatients, giving a total morbidity of 7.3% for the 1966 survey. An even more pronounced difference is seen during identical periods in USA between morbidity in New York City based on reports and morbidity in the JPSA ^a study including follow-up.

The different ways of defining morbidity and complications account for some of the differences shown in Table 2, but this factor is probably more important when one tries to interpret and compare

data such as those reviewed in the following sections. Gestational stage at abortion, parity, and health status are important factors influencing morbidity, and they will be dealt with separately later.

EARLY COMPLICATIONS IN RELATION TO THE METHOD USED

First-trimester abortions

These are performed, almost without exception, either by “classical curettage” (dilatation and curettage) or by suction curettage, otherwise known as uterine aspiration. Both methods have a low total complication rate (Table 3) compared with second-trimester abortions, but the range of complications reported by different authors varies markedly, as do their definitions of complications (6, 15, 18, 20–29). Prospective studies with direct comparison of the methods (15, 28) show somewhat superior results for uterine aspiration but perhaps not such a pro-

^a Joint Program for the Study on Abortion, see Tietze & Lewit (15).

Table 4. Complication rates (No. per 100 abortions) and deaths associated with intrauterine saline infusion

Study	No. of patients	Total rate of complications	No. of deaths	Bleeding	Infections
JPSA, Tietze & Lewit (33), USA	14 690	23.4 (major 1.7)	3 ^a	17.2	4.8
Bengtsson (34), Sweden:					
intra-amniotic	2 797	—	2 ^b	5.0 ^e	1.6 ^f
extra-amniotic	3 364	—	1 ^c	7.8 ^e	2.3 ^f
Olsen et al. (6), Denmark	6 940	4.5	3 ^d	—	—
Kerenyi et al. (35), USA	5 000	—	0	2.3	—

^a One patient (schizophrenic) committed suicide one month after the abortion; one developed hypernatraemia, convulsions, and renal failure. The third died from severe haemorrhage after partial separation of the placenta.

^b One probably related to intravenous injection; one cardiac arrest in a patient with congenital heart disease.

^c Septicaemia.

^d One patient died 13 days after abortion as a result of laparotomy for sterilization.

^e Percentage of patients requiring transfusion.

^f Symptoms of pelvic infection.

nounced difference as has sometimes been claimed (24).

Bleeding is usually not an extensive problem with first-trimester abortions (Table 3). Sometimes, however, it has been reported in a very high proportion of cases, usually combined with a high proportion of operations beyond the 12th week. Thus, Stallworthy et al. (27) in almost 800 cases terminated by uterine aspiration, report a blood loss of 500 ml or more in 17% and haemorrhage requiring transfusion in 8%.

Infection shows the same distribution as the total complication rate. The very wide range reflects the great differences in the definition of infection, ranging from a temperature of 37.5°C to peritonitis.

Incomplete evacuation of the uterus is the only complication reported slightly more often with uterine aspiration (24, 28, 30). Beric & Kupresanin (21) find the reverse to be true, but their two series are for different time periods and received different types of anaesthesia.

Perforation of the uterus is infrequent, especially when uterine aspiration is used for induced abortion in countries with a high abortion load (21, 23, 26). In England several clinics using mainly this method (up to at least 14 weeks) report a perforation rate of 0.5–2.7% (18, 25, 27). Stallworthy et al. (27), during abdominal tubal ligation after uterine aspiration, found previously undiagnosed perforations in 3 patients. Treatment is usually laparotomy and repair or hysterectomy, but conservative treatment is often

successfully applied. In the JPSA study (15), of the 187 perforations reported 88 were handled successfully with conservative treatment.

Cervical trauma parallels perforation, and is usually reported 3–5 times as frequently (15, 23, 26).

Trauma to the uterine myometrium, defined as smooth muscular tissue found during histological analysis of scrapings from the uterine cavity, is frequently reported with dilatation and curettage, and Andreev (31) reports “deep injury to the muscular wall” (in his opinion carrying a serious risk of intrauterine adhesions) to be 38 times as frequent during dilatation and curettage as during uterine aspiration.

Second-trimester abortions

Intrauterine instillation of hypertonic solutions. The most extensive experience with this method so far has been in Scandinavia and lately in USA. In Japan it was formerly used extensively but not always with safety precautions, and the method has now been abandoned there because of high complication rates (32). The complication rates found in the JPSA study (33), a retrospective survey by Bengtsson (34), a consecutive series of 5 000 saline abortions by Kerenyi et al. (35), and an analysis of reports to the Danish Medical Health Board (6) are shown in Table 4.

Bleeding is a much more frequent complication here than with first-trimester abortions. In Bengts-

son's study, which was based on an inquiry in all Swedish centres performing induced abortions, haemorrhage was said to have occurred when the patient received a blood transfusion. The fairly high rate of this complication probably reflects a generous attitude in Sweden towards replacing blood loss, but on the other hand there is evidence of a frequent decrease in coagulation factors after intra-amniotic saline instillations in otherwise uneventful cases (36–39).

Infection is less common than haemorrhage, but is more frequently seen than with first-trimester methods (5, 33, 34). The incidence of infection following instillation of hypertonic glucose is usually higher than that following saline (5, 40).

Retention of placental tissue is reported at extremely varying rates, owing to different attitudes of operating clinics. In many cases curettage is performed routinely after abortion.

The failure rate is dependent to a great extent on the patience of doctors and patients but also on the solution used, the technique applied, etc. (discussed below). Schulman et al. (96), in inducing abortion by intrauterine saline injection in 323 outpatients, experienced only one failure (with a living fetus 3 weeks later), but 13 patients took more than a week to abort. Bengtsson (34) reports a rate of 96.5% aborting after the first intra-amniotic instillation and 85.1% after the first extra-amniotic instillation. The efficiency rate for the first intra-amniotic instillation in the JPSA study (15) was 95.5%. Kerenyi et al. (35) give a corresponding figure of 98.6% success for the first instillation and 0.4% total failure for the last 1 000 patients in their series. Glucose is less efficient and failure rates of 15–22% are reported (27).

Symptoms of intravasal injection of hypertonic saline, sometimes combined with amnion embolism, are evident in a large proportion of case reports (6, 32, 34, 41, 42). The frequency of accidental transfusion is not known, but Gustavii (43), in 10 of 69 extra-amniotic instillations, by adding roentgen contrast medium could prove an immediate shift of fluid into the veins. Intravasal haemolysis (36), hypernatraemia (43, 44), and changes in blood volume (42, 44) have been seen, but marked changes seem to occur only in connexion with symptoms of intravenous injection.

Hysterotomy and hysterectomy in the JPSA study (15), showed the highest complication rates of all methods: 38.0% and 51.2%, respectively; yet Olsen et al. (6) reported a complication rate of only 2.5% for hysterotomy and sterilization in 6 544 cases.

However, all authors (6, 15, 18, 45) agree that the complications are definitely more serious. The reported incidence rates of "major" complications in connexion with hysterotomy and hysterectomy in local^a JPSA patients are 9.4% and 17.1%, respectively, compared with a total incidence of major complications of 1.6%. Vaginal hysterotomy, according to Lindahl (46), had a low immediate complication rate, but he found endometriosis in the scar in 19.8% of 840 follow-up cases.

Other methods, such as soap, Utus paste, urea instillations, bougies, laminaria tents, and Rivanol, are used in some countries to a considerable extent but are usually very poorly reported, and the complication rates are difficult to estimate. For the period 1961–66, Olsen et al. (6) report 1 275 cases aborted with cremor saponis and a complication rate of 9.1%—the highest produced by any method used in their series—and most European and American authors agree that the complications arising with the above-mentioned methods are more alarming (6, 45, 47–51). Rivanol 0.1% given by extra-amniotic instillation is possibly more promising. The abortive effect is about the same as that of saline, it has a slight oxytocic effect *in vitro* (52), and the incidence of infection seems to be low (49, 52). It is claimed to be atoxic (used as a bladder disinfectant) and actually many of the fetuses are aborted alive. However, Pytel et al. (53) cite 4 cases of renal failure possibly related to the instillation of this solution.

The numerous research projects on prostaglandins for the induction of abortion have been concerned mainly with the mechanisms of action and the effectiveness of various routes of administration. However, the substances also have pronounced systemic effects when administered by the intravenous route. Anderson & Speroff (54) in a tolerance study infused PGF_{2α} in doses of 25–200 μg/min in 10 patients. The incidence of nausea, vomiting, and diarrhoea was 90%, 5 patients developed some degree of diastolic hypertension during infusion, and another developed a severe vasovagal shock and bradycardia lasting 45 min after the infusion was stopped.

The techniques at present under investigation do not involve the intravenous route of administration. The intra-amniotic or extra-amniotic instillation of small amounts of prostaglandins (55–57) have increased the success rate and decreased the occurrence of side effects such as those mentioned above.

^a Excluding patients residing outside the service area.

The Task Force on the use of Prostaglandins for Regulation of Fertility is now working on finding the best techniques and compounds for induction of abortion.

LATE SOMATIC SEQUELAE TO INDUCED ABORTION

A large number of late sequelae have been attributed to induced abortion, without any proved cause-relationship. Some sequelae have been studied more thoroughly than others—mostly those related either to the woman's ability to conceive after abortion or to the outcome of her subsequent pregnancies.

Wynn & Wynn (58) in 1972 published a review on the side effects of induced abortion, containing a large part of all statements made against it and studies with adverse findings. This article has been much discussed in the United Kingdom and, among others, Trussell (59) and Potts & Shadbolt (60) have admirably pointed out the pitfalls in their reasoning. No gynaecologist who has performed an induced abortion ever tries to deny that it can give rise to early or late complications. But every gynaecologist also knows—which Wynn & Wynn seem to forget—that all other terminations of pregnancy, such as delivery or spontaneous abortion, also can produce the same type of complication. Furthermore, the fact that the woman applying for abortion is already pregnant must be accepted and taken into account when complications are discussed. All studies without adequate control groups (which here means comparable as regards both the previous number of pregnancies and the health and nutritional status) will show only that there are complications, and not whether this way of terminating the pregnancy is more dangerous than letting it terminate by itself (or by clandestine abortion). This is unfortunately true of most retrospective studies published on this problem.

Studies on psychiatric or emotional sequelae of induced abortion are not discussed in this paper. Such sequelae are too dependent upon national legislation and social attitudes to permit meaningful comparison of studies from different countries. The somatic sequelae most seriously investigated are discussed below.

Reduced fecundity. Retrospective studies have sometimes blamed induced abortion as the cause of infertility (61, 62). However, Hayashi & Momose (63) compared a group of women complaining of secondary infertility with a group of multigravidae

delivered at full term and found no difference between the two groups in the proportion of women having experienced an abortion. The only exception was seen among those having experienced only one previous pregnancy, where the percentage of induced abortion among infertile women was 41.1 and that in the control group 32.6—a high incidence of aborted primigravidae also in the control group.

In prospective studies by Lindahl (46), mainly involving vaginal hysterotomy, and by Jirátko et al. (64), probably covering primarily uterine aspiration, no definite evidence of reduced fecundity could be found.

Premature births and spontaneous abortions in retrospective studies from Japan (65) occurred more frequently in women with previous induced abortions, among patients with premature deliveries, spontaneous abortions, or habitual abortions, than in control groups with full-term deliveries, but the latter were not matched according to age, social group, or parity. The same is true for Dolžal et al. (66), who found a significantly higher proportion of previous induced abortions among 189 mothers with premature deliveries than in a control group of 197 women delivered of full-term babies.

Other clinical studies also have shown an increased risk of premature delivery or second-trimester abortion after an induced abortion (67–69), but the control groups are usually never matched for both parity and health status, and it remains to be shown whether this increase is caused by the abortion procedure, by factors hidden in the decision to interrupt the pregnancy, or by both. Data from Hungary, where the incidence of low birth-weight is the highest in Europe, as is the incidence of abortion, seem to indicate that other factors also play an important role. In a survey in 1970 (70) they found that the rate of live-born babies weighing less than 2.5 kg increased with the number of previous induced abortions, there being a 100% increase with 0–2 previous abortions and 200% at 4 abortions. However, the proportion of women with premature delivery but no previous abortion was also very high: 10.1%, and the total percentage was 11.8. There was a successive increase from the 1960 percentages, but this was true also for women with no previous abortions, 8% of whom that year had babies weighing less than 2.5 kg. During the same time the proportion of still births decreased at approximately the same rate as that of babies with low birth-weight increased. The Hungarian perinatal mortality study (71) showed the proportion with low

birth-weight to be higher in manual workers and in smokers than in nonmanual workers and non-smokers, and the effect of these factors was apparently of at least the same magnitude.

An increased frequency of extrauterine pregnancies has been mentioned by several authors, mainly from eastern Europe (30, 61, 72, 73). Cernoch (73) analyses the change in the numbers of ectopic pregnancies, induced abortions, and deliveries in Czechoslovakia in 1955–68, and he claims an increase in the former, parallel with the increase in induced abortions. During the years 1964–68, however, there is a decrease in the number of ectopic pregnancies in spite of a stable total number of pregnancies and a slight increase in induced abortions. Beric & Kupresanin (21) find, in Novi Sad from 1960 to 1970, an increase in the birth rate and in induced abortions but a relative decrease in the number of extrauterine pregnancies. Kurčiev et al. (72) report that 48.2% of the patients treated for extrauterine pregnancies in Skopje in 1967–68 had a previous induced abortion, but do not mention the abortion ratio in the population. Sawasaki & Tanaka (74), in 222 cases of extrauterine pregnancy among Japanese women, find that the preceding pregnancy was terminated by induced abortion in 43.8%, which does not differ significantly from the 50.2% found in a control group.

The complication rate in subsequent pregnancies and deliveries, i.e., full-term deliveries, is also claimed to be affected by previous abortion. Thus, Lembryck (69), in his group of 143 primiparae (second gravidae) with a previous interrupted pregnancy, finds a higher frequency of bleeding during pregnancy and delivery and a somewhat longer first stage of labour, but a lower rate of toxæmia and no difference in the numbers of spontaneous deliveries. His control group consisted of 143 primiparae, primigravidae. Atanasov et al. (75) found 67.5% complicated pregnancies or deliveries in 265 women with previous abortions, compared with 13.4% in 418 with no previous abortion, the main complications being bleeding and toxæmia. He does not give data on parity in the two groups. Czeizel & Bognar (13), in a preliminary analysis of legal abortions in Hungary, found a rising incidence of deliveries complicated by placenta praevia and abruptio placentae that to some extent paralleled the rise in abortions.

On the other hand, Heczko et al. (76) studied 173 parturient women who had had their first pregnancy terminated by abortion, and they found the same rate of late pregnancy and delivery complications

and the same perinatal mortality as among 18 226 other parturients during the same period. Furusawa & Koya (77) compared a large group of women terminating their first pregnancy by induced abortion and their second pregnancy by delivery with a control group of primiparae, primigravidae, matched for age and civil status. They found no significant difference in birth-weight, rate of instrumental deliveries, amount of bleeding, or length of the third stage of labour, although possibly a moderate increase in the length of the first and second stages in the group with previous abortions. Doležal et al. (66) did not find previous abortion more often in mothers giving birth to small-for-date children (<2.5 kg at term) than in mothers having children weighing more than 2.5 kg.

Evidence of the risk of Rh immunization through transplacental haemorrhage owing to induced abortion is rather convincing (78–85), although the incidence of significant transplacental haemorrhage in the first trimester is apparently lower than that in the second (79, 84). In 145 Rh-negative patients who underwent induced abortions, Queenan (84) found immunization occurring in 8 patients (5.5%), and only one of these patients showed circulating fetal erythrocytes immediately after abortion. Four of the immunized patients were 12 weeks pregnant or less.

There is little evidence of menstrual disorders after induced abortions. Mandausová & Exnerová (86), in a follow-up of 43 girls below 16 years of age, found menstrual disturbances (unspecified) in 26 patients and amenorrhoea in one. The lack of a control group, however, is especially disturbing in a study of menstrual patterns in this age group. Matsumoto & Ozawa (87), in a retrospective study, compared a group of patients with abnormal menstrual patterns and another with a normal pattern, and they found no significant difference between the two groups in the incidence of induced abortion. In a prospective study of the two cycles directly following induced abortion, the same authors showed an abnormal basal body temperature curve in 38% of first cycles compared with 8.8% of cycles in a nonpregnant control group, but the pattern was quickly restored to normal.

Thus a critical look at the literature on late sequelae of induced abortion shows that, in spite of considerable experience with legally induced abortions in some countries, we still have very little knowledge of the types of sequela that may or may not occur. This particular literature is very interesting, on the whole, when looked upon as a study of biases and their

effect upon research. The fact still remains that there is a need for unbiased, prospective or retrospective, but in either case carefully controlled, studies in this field in a large number of women.

TECHNICAL ASPECTS OF PREVENTION OF COMPLICATIONS

A considerable amount of work has been undertaken on complications in relation to the type of abortion care offered, but it is difficult to draw conclusions, owing, among other things, to the scarcity of controlled studies, the sometimes ill-defined study population, and the biases of the investigators. The following observations do not attempt to suggest any solutions but only to review data already available on these aspects.

The technical training of doctors is generally on a higher level in countries such as Hungary than in, for example, Scandinavia. In all likelihood, this is due partly to the higher abortion load in the former; however, no direct studies of the role of training have been encountered. In New York City and New York State the complication rates for operations performed by obstetrician-gynaecologists and by general practitioners have been compared (88), and the data are shown in Table 5. The numbers given are complication rates in percentages for first-trimester abortions. The numbers of saline abortions performed by the four groups of doctors were too small to allow any conclusions to be drawn.

The health status of the patient is obviously of importance for morbidity and mortality from induced abortion. Tietze & Lewit (15) report in 1 223 patients with pre-existing complications (excluding cases with simultaneous sterilization) a total complication rate (including follow-up) of 23.3%, with major complications in 3.5%, compared with the rates of 11.1% and 1.0% in healthy women.

Age influences complication rates at both ends of the fertile period, but the data presented by different authors (86, 89-91) do not consider age and parity simultaneously. Huntingford (90) finds an age-specific mortality rate, for the 17 deaths in the United Kingdom in 1969, of 9.2 per 100 000 in the age group 35-44 years, compared with 1.8 per 100 000 for the age group 20-34 years (the percentage of patients also sterilized was equal in both groups). Morbidity does not seem to be so obviously influenced in the higher age groups. Two recent surveys from Scandinavia, with 570 (89) and 450 (91) patients, respectively, both show a higher morbidity for

Table 5. Complication rates related to training level of doctors. Data from Ingraham & Longood (88)

Area	Obstetrician-gynaecologists	General practitioners
NY State	3.0 % (18/601)	10.2 % (10/98)
NY City	3.1 % (26/831)	3.5 % (5/143)

abortions before the 13th week in the younger age groups but no rise, and, according to the latter (91), possibly a decrease of morbidity in the age group above 38 years. In the JPSA study, Tietze & Lewit (unpublished observations, 1971) found an increase in complications after first-trimester abortions in the two age groups at the extreme ends—women 14 years or less and 40 years or more. For the youngest age group they demonstrated a 44% increase compared with the lowest rate, found in the age group 18-19 years. The increase in the oldest age group was almost as high: 40%. For second-trimester operations (mainly with saline) there was no rise at the extreme ends of the age scale, all age groups after 25 years having a complication rate approximately 40% higher than the average rate for the first trimester.

An influence of parity on morbidity is often postulated, and especially the deleterious effect of interruption of the first pregnancy on subsequent fertility and the danger of habitual abortions. Stallworthy et al. (27) find in their material no significant difference between the frequency of cervical trauma in primigravidae and that in multigravidae, and Drac & Nekvasilová (68) find no difference between women with termination of their first pregnancy and women with termination of later pregnancies in the incidence of premature birth and spontaneous abortion, but it is not clear how this apparently retrospective material was selected.

Atterfeldt et al. (89) studied the early complication rate (including one month's follow-up) in 171 primigravidae and 391 multigravidae, and they found in first-trimester abortions (uterine aspiration only) a significantly higher incidence among primigravidae, predominantly of infection and of "suspected infection". In the second trimester (only saline abortions) they found no significant difference in the total incidence but a greater frequency of profuse bleeding among multigravidae. Tietze & Lewit (15), on the other hand, found a somewhat lower incidence for

Table 6. Complication rates related to gestational stage. Data from Huntingford (90)

Gestation (weeks)	Uterine aspiration	Dilatation & curettage	Abdominal hysterotomy	Hysterotomy
<13	4.9	5.6	10.0	16.9
13-16	9.0	6.2	12.1	26.0
>16	22.9	1.5	8.6	10.0

primigravidae in both trimesters, with an especially pronounced decrease for the second trimester.

Gestational stage is considered in almost all papers published, and the complication rate invariably increases with increasing age in weeks. A more distinct rise can be seen after the first trimester, as in the JPSA report (15). This is not solely dependent on a shift from vaginal to other procedures, as can be seen in Table 6, where all methods represented show a higher complication rate at 13-16 weeks than before 13 weeks.

In the first-trimester abortions, Tietze & Lewit (15) reported a slightly higher incidence of complications before 7 weeks. In "abortion only" ^a local patients with follow-up, they found 7.0% compared with 5.1% from the 7th to the 8th week, which is the optimum period. They also found a maximum complication rate in the period 17-20 gestational weeks. Moberg et al. (92) analysed the early complications in 1 123 patients aborted by uterine aspiration, and found an increase in heavy bleeding with gestational stage, the rate being unacceptably high after the 11th week. For infection there was no corresponding increase.

Induced abortion in outpatient clinics has only recently been performed more extensively. For instance, Beric & Kupresanin (21) reported from the clinic in Novi Sad that 97.6% of the abortions prior to the end of the 12th week of pregnancy are performed in outpatients by means of uterine aspiration and paracervical block. Nathanson (93) reported an experience with 26 000 outpatient abortions in New York in 1970-71 with a very low complication rate. Margolis et al. (94) compared the results of uterine aspiration in 55 outpatients and in 50 inpatients and found no difference in the complication rate. The complications registered all developed between the 3rd and the 30th day after abor-

tion. In the JPSA study (15) the incidence of complications associated with uterine aspiration was lower for outpatients, the difference being more pronounced the farther advanced was the stage of pregnancy. This might have been due partly to selection of the patients according to their health status, and partly to discrepancies between estimations of the gestational stage by uterine size and by the last menstrual period.

Two series of outpatient saline abortions are reported, both without control series and with selected cases. Kerenyi (95) injected saline into 50 patients who were later hospitalized during labour and usually stayed for 2-7 h after abortion. If labour had not started after 36 h, an oxytocin infusion was started. Schulman et al. (96) report on 323 patients of whom 211 aborted at home, the others preferring to return to the clinic during labour. None of the authors find more complications with saline abortions in outpatients than in inpatients; Schulman, however, could not reach 53 of his patients for follow-up.

First-trimester operations

In uterine aspiration and in dilatation and curettage, cervical dilation is performed quickly and with force applied to a rather rigid cervical wall. The risk of rupture or tear is definitely greater the larger is the size of the uterus, thus, Lunow et al. (26) found before 9 weeks 0.9%, and at 9-12 weeks 2.5%, of cervical trauma. The "vibro-dilatator", claimed to be less traumatic, is criticized because of the increased hazard of perforation (30). Newton (97) used it for dilatation before uterine aspiration in 165 women and reported 12 cases of serious lacerations or perforations, compared with 1 case of laceration in 500 women when he used laminaria tents. Hulka and his group in Chapel Hill (98) have recently worked out a method for objectively measuring the energy needed for dilatation and are carrying out controlled studies of the effect of various anaesthetics, oxytocins, and techniques, but data have not yet been published. The 6-mm Karman cannula substantially reduces the need for dilatation in pregnancies up to 8 or 9 weeks (99). No comparative studies regarding this method have been published so far. The complication rate seems to be low, with an overall rate of 4.7% in 1 554 cases from 9 studies, but there exists possibly a greater risk for retained tissue.

The benefits of local anaesthesia, given as para- or intracervical block in first-trimester abortions, have

^a Excluding patients with pre-existing complications and/or simultaneous sterilization.

been stressed by many authors (21, 24, 100–102), but few comparative studies have been performed. Margolis et al. (94) compared the results of light general anaesthesia and of paracervical block in patients aborted by uterine aspiration, and they found a significantly smaller blood loss in the latter group. The whole procedure in the operating theatre took approximately 50 min for the latter group, compared with 30 min for the first. Tietze & Lewit (15) compared JPISA data for general and local anaesthesia in hospital outpatients and found a total complication rate of 7.2% for abortion under local anaesthesia and only 4.8% for general anaesthesia. This higher complication rate for local anaesthesia is especially true for repeated curettage owing to retention of placental tissue, which is 2–3 times more common after local anaesthesia. Major complications, on the other hand, are more frequently encountered among nonprivate patients receiving general anaesthesia.

Halothane and similar inhalation anaesthetics relax the myometrium and decrease its sensitivity to oxytocin, and they have been shown to produce a substantial increase in blood loss (92, 103, 104).

In a follow-up of 76 women with first-trimester abortion in Sweden (5), 21 of 37 women receiving local anaesthesia related that they would have preferred a general anaesthetic, whereas only 2 of 39 receiving general anaesthesia would have preferred a local anaesthetic.

Oxytocic drugs applied before or during dilatation significantly reduce the blood loss, according to several authors (21, 25, 105, 106). Johansson (107) compared this parameter in two small series of dilatation and curettage with and without intravenous infusion of oxytocin at about 1 IU/min throughout the operation. In a group of 29 patients who did not receive oxytocin 11 bled approximately 500 ml during the operation and 9 showed significant late bleeding, whereas, in another group of 84 patients who received oxytocin, 5 bled during the operation and 5 afterwards.

The type of equipment used for the abortion procedure seems to be wholly dependent on personal taste; no comparative studies on complication rates exist. The negative pressure used for uterine aspiration is important. Most authors seem to use about 0.7 atm (0.071 MPa), increasing with gestational stage but not exceeding 0.9, as the incidence of perforation is claimed to be higher with stronger suction (23, 25). Cernoch (108), on using 0.8–1.0 atm (0.081 MPa to 0.1 Mpa), in 20% of his cases found

muscular tissue among the removed tissues. Chalupa (109), using about 0.5 atm (0.051 MPa), did not succeed in removing the fetus in 5%.

Second-trimester operations

The solution most commonly used for intrauterine instillation procedures is 20% saline. This concentration seems from numerous reports to be optimum for safety and efficiency (32, 34, 40, 110). Glucose in 20–50% concentrations has a lower efficiency and a higher incidence of infection (27, 40, 111); 25% Mannitol and urea are both connected with a much lower incidence of effectiveness (47, 112–114). Rivalon and other methods were reviewed above.

Abdominal puncture is the prevailing technique for intra-amniotic injection in most clinics. The transvaginal route was described by Ruttner (115), who had good results in a small series, but this technique has never become popular. Instillation through a catheter is preferred by some authors (34, 116) as it seems to minimize the risk of intravascular injection. The amount of amniotic fluid removed seems unimportant for effectiveness; Reiss (116) had good results in 84 cases by removing no fluid at all before injecting the saline. There is no evidence that the amount of saline injected plays a major role in the failure rate, but amounts of less than 100 ml tend to have a reduced effect (33, 34, 117). Amounts of sodium chloride exceeding 40 g should be avoided, even in patients with normal renal function, as they substantially increase the risk of deleterious hypernatraemia and renal dysfunction (32, 34, 118, 119).

The extra-amniotic technique is rather extensively used in Scandinavia in spite of its somewhat lower efficiency (34), probably because the procedure is considerably easier. Bleeding and infection are slightly more common after extra-amniotic than after intra-amniotic injection.

Oxytocic infusions are extensively used to shorten the time lapse between injection and abortion, and most authors claim that they have this effect (110, 112, 113, 118, 120), but few valid controlled studies exist. Cheng & Ratnam (120) administered oxytocin 24 h after injection into 24 patients in increasing doses up to 80 IU/500 ml and 50% aborted within 30 h, but this does not seem to differ significantly from Kerenyi's results with 200 patients *not* receiving oxytocin and a mean abortion time of 36.5 h (95). There is evidence that the effect might be both dose- and time-dependent. Mackenzie et al. (121) gave oxytocin in doses of 100–200 IU in 500 ml of saline infused at a speed of 12 drops per

minute until the patient aborted, starting within 12 h of injection in 283 patients and after 12 h in 105 patients. The mean time lapses were 22 h and 32 h, respectively, and the difference is statistically significant. Several authors have shown that, during the first hours after saline injection, a temporary decrease in urinary output and/or changes in blood volume often occur (42, 44). Oxytocin has a fairly weak antidiuretic effect, but in doses of 600–1 000 IU in a few hours and combined with high water loads (122) the risk of water intoxication is evident even in patients with healthy kidneys. The optimum range of oxytocin in blood for the stimulation of mid-trimester pregnancy myometrium, according to Caldeyro-Barcia and Sareno (123), is 0.12–0.25 IU/min, which corresponds well to the dose used by Mackenzie et al. (121)—i.e., 100 IU in 500 ml of fluid at 12 drops/min, with no difference in effect produced when this dose was doubled.

Antibiotic prophylaxis is used to some extent in connexion with both first- and second-trimester abortions, but few authors seem convinced of its effectiveness. In a comparative study of saline abortions, Mackenzie et al. (121) gave prophylactic antibiotics to 110 patients, 56 not receiving prophylaxis. There was fever in 4 of the former and 9 of the latter.

Sterilization in combination with abortion operation

The simultaneous operation is claimed to raise the mortality rate above the rate associated with abortion only. In 1969 there were 17 deaths associated with legal abortion in the United Kingdom; 12 of these were women sterilized at the time of abortion. That year 35% of the women aborted were also sterilized (124). Olsen et al. (6) reported 8 abortion deaths from Denmark during 1961–66, 4 of which were also associated with sterilization. Hysterotomy and sterilization (responsible for 3 of the fatal cases) accounted for 24% of abortions during that time. Huntingford (14) analysed the 17 deaths in the United Kingdom in 1969 regarding age and gestational stage and found that these factors are much less important than is the connexion with sterilization. The mortality from abortion alone is 1/100 000 and from abortion with sterilization 11/100 000.

A way to reduce this mortality is pointed out by Steptoe (125), who performed laparoscopic sterilization at the time of uterine aspiration in 101 cases, with apparently much less operation trauma. Vaginal tubal ligation in connexion with uterine aspiration was also advocated by Sogolow (126), but he

had in his 127 cases a fairly high complication rate: 9.9% with unspecified infections and 4.1% bleeding more than 800 ml at operation.

Tietze & Lewit (15) found a two- to three-fold increase in morbidity in healthy patients with and without sterilization, when uterine aspiration or dilatation and curettage were combined with tubal ligation, but no increase when saline or hysterotomy was chosen. In 266 patients uterine aspiration was combined with sterilization *via* the laparoscope without an increase in morbidity.

From the British data on mortality from abortion in combination with sterilization, Huntingford draws the conclusion that the two operations should always be performed on separate occasions (14). However, judging from the JPSA study, such a general conclusion is not justified. The combination of uterine aspiration or dilatation and curettage with abdominal tubal ligation certainly gives an increase in the complication rate compared with abortion only, but as far as all other combinations are concerned no pronounced increase is evident. A definite answer to this question has to await further analysis, which must take into account mortality and morbidity caused by two surgical interventions made separately in the same patient.

DISCUSSION

A study of the literature reveals that there is a wide range of opinions on the incidence and definition of complications after induced abortion. To overcome the current disparity of views, complications should be defined in a uniform way and uniform criteria should be established for follow-up reporting.

Knowledge on late somatic sequelae is particularly scarce. Very few have actually been proved to be harmful effects resulting from the procedure *per se* and not from other interfering factors. Prospective studies on fertility are difficult to perform, owing to the high drop-out rates expected among patients and to the small number of women with a history of induced abortion that can be expected to plan a pregnancy during the years immediately following the abortion. Retrospective studies, carefully designed and with matched controls, could probably yield valuable information on the incidence of infertility, prematurity, and events such as extrauterine pregnancy in women with a history of abortion.

Designs for such studies have been worked out by

the Task Force on Sequelae and Complications of Induced Abortion, within the WHO Expanded Programme of Research Development and Research Training in Human Reproduction. The studies will be performed in several countries and it is to be hoped that they will yield valid information within a few years on the role of the abortion operation in the etiology of, for instance, the higher prematurity rate in aborted women.

As to techniques for the interruption of pregnancy, it seems clear that most investigators consider uterine aspiration to be the method of choice during the first trimester. It is more difficult to recommend a certain method for second-trimester abortions. Instillation of prostaglandin compounds *in utero* is regarded by many as being a promising method.

This method is at present under investigation by the Task Force on the Use of Prostaglandins for the Regulation of Fertility.

A number of other aspects of abortion care, such as inpatient *versus* outpatient care and the type of anaesthesia used, have been well elucidated in large numbers of patients. However, these data reflect mainly the effects of liberally performed abortions in countries with a high technical standard and a fairly healthy population. One cannot use these data to predict the complication rate in a country that is starting to perform induced abortions on a large scale in a population with lower levels of health and nutritional status. Investigations into these problems are also within the scope of the above-mentioned task forces.

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RÉSUMÉ

COMPLICATIONS IMMÉDIATES ET SÉQUELLES TARDIVES DE L'AVORTEMENT PROVOQUÉ: EXAMEN DE LA LITTÉRATURE

Les ouvrages traitant des techniques abortives et des complications de l'avortement provoqué sont très abondants mais la définition de ces complications est extrêmement variable, soit en raison de l'opinion des auteurs à l'égard des techniques utilisées, soit en raison d'autres facteurs d'influence. En outre, les taux de complications varient aussi selon les méthodes employées pour la collecte des données et les possibilités d'avortement légal offertes par chaque pays. C'est dire que le lecteur qui souhaite connaître les risques relatifs des diverses méthodes et des avortements légaux a bien de la peine à y voir clair. Dans la présente étude de la littérature consacrée à ce sujet, nous avons tenté, d'une part, de mettre en évidence les informations valables existantes et, d'autre part, d'indiquer les principaux domaines où des recherches sont encore nécessaires.

Les taux nationaux de mortalité et de morbidité montrent que les pays qui comptent un grand nombre d'avortements et en particulier d'avortements au cours des trois premiers mois de la grossesse ont un taux de complications relativement faible. Des études plus

spécifiques font apparaître que les facteurs qui influent le plus sur les taux de complications sont le stade de la grossesse, l'état de santé de la mère, la méthode employée et l'association de l'avortement avec la ligature des trompes. En ce qui concerne les interruptions de grossesse pratiquées au cours des trois premiers mois, c'est la technique de l'aspiration utérine qui est la moins traumatisante, surtout lorsqu'elle est pratiquée très tôt au moyen d'une fine canule et sans dilatation. Pour ce qui est des interruptions de grossesse au cours du second trimestre, les instillations de solutions hypertoniques, de rivanol, ou — mieux encore peut-être — de prostaglandines semblent entraîner moins de risque que les autres techniques. Les complications graves avec les solutions salines hypertoniques sont très rares et peuvent être presque complètement évitées si l'on utilise une bonne technique d'instillation et si l'on observe les précautions voulues. Les facteurs tels que l'âge, la parité, les services offerts, et l'anesthésie semblent avoir moins d'importance.

L'existence de séquelles à long terme a fait l'objet de très nombreuses études mais, par rapport au nombre

total des avortements pratiqués, celui des données disponibles est très peu élevé. Il semble qu'il y ait une relation entre l'avortement provoqué et la naissance ultérieure de nouveau-nés de poids faible mais jusqu'ici, on n'a pas démontré si les naissances de poids faible étaient liées à l'opération d'interruption de grossesse ou à quelque autre facteur également courant chez les intéressées.

En général, les autres séquelles étudiées sont également associées aux grossesses ultérieures. On mentionne des complications au cours de la grossesse et au moment de l'accouchement, une prolongation du travail, et une augmentation de la mortalité fœtale, mais la relation entre ces faits et les avortements provoqués n'a pas été clairement établie. Il en est de même en ce qui concerne l'infécondité et les troubles menstruels. Les effets psychologiques de l'interruption de grossesse ne sont pas examinés dans le présent document. La variabilité des attitudes à l'égard de l'avortement dans les divers pays joue, à cet égard, un rôle essentiel et le problème se complique encore du fait des fluctuations continues d'opinion.

Le domaine de recherche qui réclame le plus d'efforts est celui des séquelles à long terme. Pour établir le rôle étiologique des opérations d'avortement, les études doivent porter sur de larges groupes de femmes avortées et sur des groupes témoins bien définis de manière que d'autres facteurs soient pris en compte notamment l'état de santé des intéressées, leur âge et leur parité, et leur situation socio-économique. Pour ce qui est des complications immédiates de l'avortement provoqué, on dispose de bonnes données recueillies en Europe et aux Etats-Unis d'Amérique mais il n'est pas possible de prédire, sur la base de ces données, les effets que pourrait avoir une augmentation subite du nombre des avortements provoqués, dans une population moins bien nutrie et moins bien portante.

L'Organisation mondiale de la Santé soutiendra plusieurs recherches dans ce domaine, faites dans diverses régions. Le Groupe de travail sur les séquelles et les complications de l'avortement provoqué a déjà conçu 5 études, et une sous-section de ce groupe s'emploie à élucider les séquelles psychologiques et psycho-sociales éventuelles de l'interruption de grossesse.

REFERENCES

1. DAVID, H. P. Family planning and abortion in the socialist countries of central and eastern Europe. New York, Population Council, 1970.
2. TIETZE, C. Somatic consequences of abortion. In : Newman, S. H., Beck, M. B., & Lewit, S., ed. Abortion, obtained and denied—research approaches. New York, Population Council, 1971.
3. TIETZE, C. ET AL. Mortality with legal abortion in New York City 1970-72. *Journal of the American Medical Association*, **225** (5): 507-509 (1973).
4. OFFICE OF POPULATION CENSUSES AND SURVEYS. The Registrar General's statistical review of England and Wales for the year 1971. Supplement on abortion. London, 1973.
5. SWEDISH BOARD OF HEALTH AND SOCIAL WELFARE. In : Rätten till Abort [The right to an abortion]. Stockholm, Department of Justice, 1971, Vol. 58, p. 49 & Appendix 4 (Statens offentliga utredningar 1971: 58).
6. OLSEN, C. E. ET AL. Complications to therapeutic abortions. *International journal of gynaecology and obstetrics*, **8**: 823-829 (1970).
7. HONG, S. B. Abortion and mortality. In : Hall, R. E., ed. Abortion in a changing world. New York & London, Columbia University Press, 1970, Vol. II, pp. 125-126.
8. MURAMATSU, M. Abortion and mortality. In : Hall, R. E., ed. Abortion in a changing world, New York & London, Columbia University Press, 1970, Vol. II, pp. 122-123.
9. KESTELMAN, P. Mortality and morbidity of abortion. *Lancet*, **2**: 368-369 (1971).
10. PAKTER, J. & NELSON, F. Abortion in New York City: the first nine months. *Family planning perspectives*, **3** (3): 5-12 (1971).
11. SMITH, R. G. ET AL. Abortion in Hawaii: the first 124 days. *American journal of public health*, **61**: 530-542 (1971).
12. MEHLAN, K. H. Changing patterns of abortion in the socialist countries of Europe. *Family planning news*, **10** (10): 2-7 (1969).
13. CZEIZEL, A. & BOGNAR, Z. Mortality and morbidity of legal abortion. *Lancet*, **2**: 209-210 (1971).
14. HUNTINGFORD, P. J. Mortality and morbidity of abortion. *Lancet*, **1**: 1012-1013 (1971).
15. TIETZE, C. & LEWIT, S. Joint Program for the Study on Abortion (JPSA): Early medical complications of legal abortion. *Studiés on family planning*, **3**: 97-122 (1972).
16. BOGNAR, Z. [The development of acute complications after abortions in the capital in 1966]. *Népegészségügy*, **50**: 18-20 (1969).
17. STERNADEL, Z. ET AL. [Some aspects of artificial abortions, performed in clinical conditions]. *Ginekologia Polska*, **39**: 127-130 (1968).
18. SOOD, S. V. Some operative and postoperative hazards of legal termination of pregnancy, *British medical journal*, **4**: 270-273 (1971).

19. KUCK, M. Abortion in Czechoslovakia. *Proceedings of the Royal Society of Medicine*, **62**: 831-832 (1969).
20. ATANASOV, A. [Complications after interruption of pregnancy due to the method used—classical or aspiration]. *Akušerstvo i ginekologija (Sofia)*, **9**: 271-277 (1971).
21. BERIC, B. M. & KUPRESANIN, M. Vacuum aspiration, using paracervical block, for legal abortion as an outpatient procedure up to the 12th week of pregnancy. *Lancet*, **2**: 619-621 (1971).
22. BOBČEV, B. & MIHNEVA, O. [Our experience in the usage of aspiration method for interruption of pregnancy]. *Akušerstvo i ginekologija (Sofia)*, **6**: 143-145 (1967).
23. JURUKOVSKI, J. & SUKAROV, L. A critical review of legal abortion. *International journal of gynaecology and obstetrics*, **9**: 111-117 (1971).
24. KERSLAKE, D. & CASEY, D. Abortion induced by means of the uterine aspirator. *Obstetrics and gynecology*, **30**: 35-45 (1967).
25. LOUNG, J. ET AL. Results in 1000 cases of therapeutic abortion managed by vacuum aspiration. *British medical journal*, **4**: 477-479 (1971).
26. LUNOW, E. ET AL. [Early gynaecological complications in a series of legal abortions]. *Zentralblatt für Gynäkologie*, **93**: 49-58 (1971).
27. STALLWORTHY, J. A. ET AL. Legal abortion: a critical assessment of its risks. *Lancet*, **2**: 1245-1249 (1971).
28. VLADOV, E. ET AL. Termination of pregnancy with vacuum aspiration. *Gynaecologia*, **159**: 54-60 (1965).
29. VOJTA, M. A critical view of vacuum aspiration: a new method for the termination of pregnancy. *Obstetrics and gynecology*, **30**: 28-34 (1967).
30. NOVAK, F. Worldwide problems of abortion—Europe. *Pakistan medical forum*, **6** (8): 33-43 (1971).
31. ANDREEV, D. [Comparative histological investigations on the evacuated uterine mucous membrane in the vacuum-exochleation and classical methods of interruption of pregnancy]. *Folia medica (Plovdiv)*, **11**: 88-96 (1969).
32. WAGATSUMA, T. Intra-amniotic injection of saline for therapeutic abortion. *American journal of obstetrics and gynecology*, **93**: 743-745 (1965).
33. TIETZE, C. & LEWIT, S. Joint Program for the Study of Abortion (JPISA): Early medical complications of abortion by saline. *Studies on family planning*, **4** (6): 133-138 (1973).
34. BENGTTSSON, L. P. Therapeutic abortion by means of intra-uterine injections. *Medical gynaecology and sociology*, **3**: 6-14 (1968).
35. KERENYI, T. D. ET AL. Five thousand consecutive saline inductions. *American journal of obstetrics and gynecology*, **116**: 593-600 (1973).
36. EDSTRÖM, K. & ODAR-CEDERLÖF, J. Therapeutic abortion by means of intra-uterine instillation of hypertonic saline: Evidence of hemolysis following accidental intravenous injection. *International journal of obstetrics and gynaecology*, **12**: 35-45 (1974).
37. TALBERT, R. W. ET AL. Studies on the pathogenesis of clotting defects during salt-induced abortions. *American journal of obstetrics and gynecology*, **115**: 656-658 (1973).
38. STANDER, R. W. ET AL. Changes in maternal coagulation factors after intraamniotic injection of hypertonic saline. *Obstetrics and gynecology*, **37**: 660-666 (1971).
39. LAROS, R. K. ET AL. Coagulation changes in saline abortions. *American journal of obstetrics and gynecology*, **116**: 277-286 (1973).
40. WEISE, W. ET AL. [Critical study of single-time and double-time methods of pregnancy termination]. *Zentralblatt für Gynäkologie*, **92**: 841-848 (1970).
41. CAMERON, J. M. & DAYAN, A. D. Association of brain damage with therapeutic abortion induced by amniotic fluid replacement: Report of two cases. *British medical journal*, **1**: 1010-1013 (1966).
42. FUTORAN, J. M. ET AL. Experience with intra-amniotic hypertonic saline injections: Aburel's procedure. *American journal of obstetrics and gynecology*, **105**: 191-196 (1969).
43. GUSTAVII, B. Studies on accidental intravenous injection in extra-amniotic saline induced abortion and a method for reducing this risk. *Journal of reproductive medicine*, **8**: 70-74 (1972).
44. ANDERSON, A. B. M. & TURNBULL, A. C. Changes in amniotic fluid, serum and urine following the intra-amniotic injection of hypertonic saline. *Acta obstet. gyn. scand.*, **47**: 1-21 (1971).
45. WORASCK, H. J. & BERNDT, J. [Clinical experience with various methods of pregnancy termination]. *Zentralblatt für Gynäkologie*, **91**: 6-12 (1969).
46. LINDAHL, J. Somatic complications following legal abortion. London, Heinemann Medical Books, 1959 (Scandinavian University Books).
47. GREENHALF, J. O. & DIGGORY, P. L. C. Induction of therapeutic abortion by intra-amniotic injection of urea. *British medical journal*, **1**: 28-29 (1971).
48. LACHELIN, G. C. L. & BURGESS, D. E. Therapeutic abortion using Utus paste. *Journal of obstetrics and gynaecology of the British Commonwealth*, **75**: 1173-1175 (1968).
49. MANABE, Y. Artificial abortion at midpregnancy by mechanical stimulation of the uterus—a review of 20 years' experience with current methods in Japan. *American journal of obstetrics and gynecology*, **105**: 132-146 (1969).
50. SOOD, S. V. Termination of pregnancy by the intrauterine insertion of Utus paste. *British medical journal*, **2**: 315-317 (1971).
51. WALKER, A. H. C. Termination of pregnancy using Utus paste. *Proceedings of the Royal Society of Medicine*, **62**: 832 (1969).

52. LEWIS, B. V. ET AL. The oxytocic effect of acridine dyes and their use in terminating mid-trimester pregnancies. *Journal of obstetrics and gynaecology of the British Commonwealth*, **78**: 838-842 (1971).
53. PYTEL, A. Y. ET AL. [Acute renal insufficiency associated with intrauterine retromembranous administration of rivanol for the interruption of pregnancy and its treatment with hemodialysis]. *Akušerstvo i Ginekologija (Moskva)*, **39**: 5 (1963).
54. ANDERSON, G. G. & SPEROFF, L. Prostaglandins and abortion. *Clinical obstetrics and gynecology*, **15**: 245-257 (1971).
55. WIQVIST, N. ET AL. Intra-amniotic prostaglandin administration—A challenge to currently used methods for induction of mid-trimester abortion. *Contraception*, **8**: 113-131 (1973).
56. WIQVIST, N. ET AL. Induction of abortion by extra-amniotic prostaglandin administration. *Prostaglandin*, **1**: 37 (1972).
57. KARIM, S. M. M. ET AL. Termination of second trimester pregnancy with intra-amniotic administration of prostaglandin E₂ and F_{2a}. In: Southern, E. M., ed. The prostaglandins. New York, Futura, 1972, p. 403.
58. WYNN, M. & WYNN, A. Some consequences of induced abortion to children born subsequently. London, Foundation for Education and Research in Childbearing, 1972, pp. 8-31.
59. TRUSSELL, J. Third thoughts on abortion. *British journal of hospital medicine*, **9** (5): 601 (1973).
60. POTTS, M. & SHADBOLT, R. Long term side effects of abortion. *Family planning*, **22**: 1 (1973).
61. KOTASEK, A. Artificial termination of pregnancy in Czechoslovakia. *International journal of gynecology and obstetrics*, **9**: 118-119 (1971).
62. MEHLAN, K. H. Abortion in eastern Europe. In: Hall, R. E., ed. Abortion in a changing world. New York & London, Columbia University Press, vol. I, pp. 302-314.
63. HAYASHI, M. & MOMOSE, K. Statistical observation on artificial abortion and secondary sterility. In: Harmful effects of induced abortion. Tokyo, Family Planning Federation of Japan, 1966, pp. 36-43.
64. JIRÁTKO, K. ET AL. [Sterility after artificial interruption of first pregnancy]. *Československá gynecologie*, **35**: 397-398 (1970).
65. MORIYAMA, Y. & HIROKAWA, O. The relationship between artificial termination of pregnancy and abortion or premature birth. In: Harmful effects of induced abortion. Tokyo, Family Planning Federation of Japan, 1966, pp. 64-73.
66. DOLEŽAL, A. ET AL. [Interruptions of pregnancy and their relation to premature labour and hypotrophic fetuses]. *Československá gynecologie*, **35**: 331 (1970).
67. WRIGHT, C. S. W. ET AL. Second-trimester abortion after vaginal termination of pregnancy. *Lancet*, **1**: 1278-1279 (1972).
68. DRAC, P. & NEKVASILOVÁ, Z. [Premature termination after previous interruption of pregnancy]. *Československá gynecologie*, **35**: 332-333 (1970).
69. LEMBRYCH, S. Schwangerschaftsgeburts- und Wochenbettverlauf nach künstlicher Unterbrechung der ersten Gravidität. *Zentralblatt für Gynäkologie*, **94** (5): 164-168 (1972).
70. HUNGARIAN CENTRAL STATISTIC OFFICE. [Report on the effect of the numbers of abortions on premature births and perinatal mortality in Hungary]. Budapest, 1972.
71. HUNGARIAN CENTRAL STATISTIC OFFICE. [Perinatal mortality]. Budapest, 1972.
72. KURČEV, K. ET AL. [Abortion as a cause of extrauterine pregnancy]. *Godišen zbornik na Meditsinskiot Fakultet vo Skopje*, **16**: 405-410 (1970).
73. CERNOCH, A. Künstliche Schwangerschaftsunterbrechung und extrauterine Schwangerschaft. *Zentralblatt für Gynäkologie*, **93** (52): 1784-1791 (1971).
74. SAWAZAKI, C. & TANAKA, S. The relationship between artificial abortion and extrauterine pregnancy. In: Harmful effects of induced abortion. Tokyo, Family Planning Federation of Japan, 1966, pp. 49-63.
75. ATANASOV, A. ET AL. [Some peculiarities in the course of pregnancy and delivery in women who had preceding abortions]. *Akušerstvo i ginekologija (Sofia)*, **10**: 456-459 (1971) (with English summary).
76. HECZKO, P. ET AL. [The effect of interruption of first pregnancy on later gestation]. *Československá gynecologie*, **35**: 333-334 (1970).
77. FURUSAWA, Y. & KOYA, T. The influence of artificial abortion on delivery. In: Harmful effects of induced abortion. Tokyo, Family Planning Federation of Japan, 1966, pp. 74-83.
78. BOWMAN, J. M. Transplacental haemorrhage after abortion. *Lancet*, **1**: 1108 (1970).
79. LAKOFF, K. M. ET AL. Transplacental hemorrhage during voluntary interruption of pregnancy. *Journal of reproductive medicine*, **6**: 260-261 (1971).
80. MATTHEWS, C. D. & MATTHEWS, A. E. B. Transplacental haemorrhage in spontaneous and induced abortion. *Lancet*, **1**: 694-695 (1969).
81. MURRAY, S. ET AL. Transplacental haemorrhage after abortion. *Lancet*, **1**: 631-634 (1970).
82. NEUBAUER, G. Transplacental haemorrhage after abortion. *Lancet*, **1**: 952 (1970).
83. PARMLEY, T. H. ET AL. Transplacental hemorrhage in patients subjected to therapeutic abortion. *American journal of obstetrics and gynecology*, **106**: 540-542 (1970).
84. QUEENAN, J. T. ET AL. Role of induced abortion in Rhesus immunization. *Lancet*, **1**: 815-817 (1971).
85. WALSH, J. J. & LEWIS, B. V. Transplacental haemorrhage due to termination of pregnancy. *Journal of obstetrics and gynaecology of the British Commonwealth*, **77**: 133-136 (1970).

86. MANDAUŠOVÁ, O. & EXNEROVÁ, E. [Sequels of artificial interruption of pregnancy in juvenile persons]. *Československá gynekologie*, **35**: 402-404 (1970).
87. MATSUMOTO, S. & OZAWA, M. Artificial termination of pregnancy and menstrual abnormality. In: Harmful effects of induced abortion. Tokyo, Family Planning Federation of Japan, 1966, pp. 27-35.
88. INGRAHAM, H. S. & LONGOOD, R. J. Abortion in New York State since July 1970. *Clinical obstetrics and gynecology*, **14**: 5-24 (1971).
89. ATTERFELT, P. ET AL. [Early somatic complications of abortion operations]. *Läkartidningen*, **69**: 241-246 (1972).
90. HUNTINGFORD, P. J. The Abortion Act (1967) in England and Wales. In: Nazer, I., ed. Induced abortion—a hazard to public health. Beirut, International Planned Parenthood Federation, 1971.
91. LAURITSEN, J. G. & HAACK-SÖRENSEN, P. E. [Legal induced abortion. The first year under the new law]. *Ugeskrift for læger*, **134**: 405-410 (1972).
92. MOBERG, P. ET AL. The hazards of vacuum aspiration in late first trimester abortions. *Acta obstet. gyn. scand.*, **54**: 113-118 (1975).
93. NATHANSON, B. N. Ambulatory abortion: experience with 26,000 cases. *New England journal of medicine*, **286**: 403-407 (1972).
94. MARGOLIS, A. J. ET AL. Therapeutic abortion without hospitalization. In: Sobrero, A. B. & Harvey, R. M., ed. Advances in planned parenthood. Amsterdam, Excerpta Medica International Congress Series No. 224, vol. VI, 1971, pp. 165-171.
95. KERENYI, T. D. Outpatient intra-amniotic injection of hypertonic saline. *Clinical obstetrics and gynecology*, **14**: 124-140 (1971).
96. SCHULMAN, H. ET AL. Outpatient saline abortion. *Obstetrics and gynecology*, **37**: 521-526 (1971).
97. NEWTON, B. W. The art of abortion. I. Curettage of the pregnant uterus. *Postgraduate medicine*, **50**: 131-136 (1971).
98. OMRAN, K. F. & HULKA, J. F. New developments in abortion technology. In: Nazer, I., ed. Induced abortion—a hazard to public health. Beirut, International Planned Parenthood Federation, 1971.
99. VAN DER VLUGT, T. & POITROW, P. T. Pregnancy termination, menstrual regulation—What is it? *Population report series F*, No. 2, 1973.
100. LEWIS, S. C. ET AL. Outpatient termination of pregnancy. *British medical journal*, **4**: 606-610 (1971).
101. PENFIELD, A. J. Abortion under paracervical block. *NY State journal of medicine*, **71**: 1185-1189 (1971).
102. STRAUSS, I. K. & SCHULMAN, H. 500 outpatient abortions performed under local anaesthesia. *Obstetrics and gynecology*, **38**: 199-205 (1971).
103. CRAWFORD, J. S. The place of halothane in obstetrics. *British journal of anaesthesia*, **34**: 386-390 (1962).
104. MARGOLIS, A. J. ET AL. In: Lewit, S., ed. Proceedings of the National Conference on Abortion Techniques and Services. Amsterdam, Excerpta Medica International Congress Series, No. 225, 1972.
105. ATANASOV, A. A combined application of the aspiration method and abortion forceps in induced abortion between 13-18 weeks of gestation. *Akušerstvo i Ginekologija* (Sofia), **9**: 223-228 (1970).
106. STERNADEL, Z. & WOJCIK, M. The application of syntometrin preparation in cases of evacuation of the conceptus from the uterine cavity. *Ginekologia Polska*, **40**: 377-380 (1969).
107. JOHANSSON, E. D. B. The effect of oxytocin on the complication rate of early therapeutic abortions. *Acta obstet. gyn. scand.*, **49**: 129-131 (1970).
108. CERNOCH, A. Experience with intrauterine suction for artificial termination of early pregnancy. In: Uterine aspiration procedures, 6th ed. Wilmington, DE, Lalor Foundation, 1971, Section 6, pp. 12-20.
109. CHALUPA, M. Use of vacuum for artificial interruption of pregnancy. *Zentralblatt für Gynäkologie*, **86**: 1803-1808 (1964).
110. WATTEVILLE, H. de. Therapeutic interruption of pregnancy by intra-amniotic injection of 10% saline solution. *Proceedings of the Royal Society of Medicine*, **62**: 828-830 (1969).
111. DROEGEMUELLER, W. & GREER, B. E. Saline vs. glucose as a hypertonic solution for abortion. *American journal of obstetrics and gynecology*, **108**: 606-609 (1970).
112. CRAFT, I. L. & MUSA, B. D. Hypertonic solutions to induce abortion. *British medical journal*, **2**: 49 (1971).
113. NEWTON, B. W. The art of abortion. 2. Induction of labour and other methods. *Postgraduate medicine*, **50**: 213-220 (1971).
114. PUGH, M. ET AL. Induction of therapeutic abortion with urea. *British medical journal*, **1**: 345 (1971).
115. RUTTNER, B. Termination of midtrimester pregnancy by transvaginal intra-amniotic injection of hypertonic solutions. *Obstetrics and gynecology*, **28**: 601 (1966).
116. REISS, H. E. Termination of pregnancy by use of intra-amniotic hypertonic saline. *Proceedings of the Royal Society of Medicine*, **62**: 832-833 (1969).
117. EDSTRÖM, K. [Views on the choice of surgical methods for legal abortion]. *Obstetrik gynekologi. (Lund)*, **4**: 218-229 (1968).
118. GOODLIN, R. C. ET AL. Therapeutic abortion with hypertonic intra-amniotic saline—a clinical experience in a combined community-university hospital. *Obstetrics and gynecology*, **34**: 1-6 (1969).
119. KERENYI, T. D. Hyponatremia following intrauterine instillation of hypertonic saline solution. *Obstetrics and gynecology*, **33**: 520-527 (1969).
120. CHENG, M. C. E. & RATNAM, S. S. Intrauterine injection of 20% saline for inducing abortion. *Singapore medical journal*, **12**: 259-263 (1971).

121. MACKENZIE, J. M. ET AL. Midtrimester abortion: clinical experience with amniocentesis and hypertonic instillation in 400 patients. *Clinical obstetrics and gynecology*, **14**: 107-123 (1971).
 122. HART, T. M. In : Hart, T. M., ed. Proceedings of the First American Symposium on Office Abortions, San Francisco, 16 May, 1970. San Francisco, Society for Humane Abortion, 1970.
 123. CALDEYRO-BARCIA, R. & SERENO, J. A. The response of the human uterus to oxytocin throughout pregnancy. In : Caldeyro-Barcia, R. & Heller, H., ed. Oxytocin. New York, Pergamon Press, 1961, p. 117.
 124. POTTS, D. M. & BRANCH, B. N. Legal abortion in the USA. *Lancet*, **2**: 651-653 (1971).
 125. СТЕПТОВЕ, P. C. Recent advances in surgical methods of control of fertility and infertility. *British medical bulletin*, **26**: 60-64 (1970).
 126. SOGOLOW, S. R. Vaginal tubal ligation at time of vacuum curettage for abortion. *Obstetrics and gynecology*, **38**: 888-892 (1971).
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