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**INTERNATIONAL JOURNAL OF  
 ADVANCED RESEARCH (IJAR)**

Article DOI:10.21474/IJAR01/4972  
 DOI URL: <http://dx.doi.org/10.21474/IJAR01/4972>



### RESEARCH ARTICLE

#### DIRECT CAUSES OF MATERNAL DEATH AN AUTOPSY STUDY.

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#### Manuscript Info

##### Manuscript History

Received: 27 May 2017  
 Final Accepted: 29 June 2017  
 Published: July 2017

##### Key words:-

Maternal death, direct maternal deaths,  
 indirect maternal deaths,  
 haemorrhages, medico legal autopsy,  
 maternal mortality ratio

#### Abstract

**Background:** Autopsy is an important tool in the investigation of maternal death. It provides valuable information about pathophysiological changes in various organs which may be important in the delineation of the sequence of events leading to maternal death. The present study was conducted at Department of forensic medicine, Government Medical College, Thiruvananthapuram, Kerala during 1995 January to April 2003. The circumstances which lead to medico legal autopsy in maternal deaths were, cases either brought dead to casualty, referred due to obstetrical complications from distant hospitals, and allegations of medical negligence in the care and management by relatives which later turn into a medico legal case..

##### Aim:

1. To detect the spectrum of causes leading to maternal death subjected to medico legal autopsy
2. To identify the direct causes of maternal deaths
3. To suggest measures to prevent maternal deaths

**Materials and methods:** Sixty-five cases brought for Medico legal autopsy during the period from January 1995 to April 2003 were included in the present retrospective/prospective study.

**Result:** 31 cases (48%) of maternal deaths were in the age group 25-29 years, and most were primigravida. Direct maternal death were the leading cause in 39 cases (60%), among them haemorrhage was the prime cause of death, i.e. 15 cases (23%). 24 cases (36.9%) were due to indirect causes and 2 cases were fortuitous deaths.

**Conclusion:** Death following obstetric haemorrhage remains the prime direct cause of maternal death, which can be tackled by active management of third and fourth stage of labour. A multidisciplinary approach with regular audit, mortality conferences, promoting autopsy in maternal death will help to identify the causes and to prevent maternal deaths. Though the risk of death from complications of pregnancy has decreased during the past few decades in India, it continues to remain higher in other developing countries.

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#### Introduction:-

According to World Health Organization (WHO), "A *maternal death is defined as death of a woman while pregnant or within 42 days of termination of pregnancy, irrespective of the duration and site of pregnancy, from*

*any cause related to or aggravated by pregnancy or its management but not from accidental or incidental causes* “(ICD-10)<sup>1</sup>.

Maternal deaths can be classified into four broad groups<sup>2</sup>

**Direct maternal Deaths:-**

Death resulting from obstetric complications of the pregnant state (pregnancy, labour and the puerperium) from interventions, omissions, incorrect treatment or from chain of events resulting from any of the above.

**Indirect maternal Deaths:-**

Death resulting from previous existing disease, or disease that developed during pregnancy and which was not due to direct obstetric causes, but which was aggravated by physiological effects of pregnancy.

**Late Death:-**

Death occurring between 42 days and one year after abortion, miscarriage or delivery that are due to direct and fortuitous maternal causes.

**Fortuitous Deaths:-**

Death from unrelated causes, which happen to occur during pregnancy or puerperium. E.g.: accidental and or unnatural death.

The **Maternal mortality rate** (MMR) is the annual number of female **deaths** per 100,000 live births from any cause related to or aggravated by pregnancy or its management (excluding accidental or incidental causes)<sup>3</sup>. Maternal mortality reflects the quality of obstetric care in a community. To achieve better mother and child health, the health care services must be accessible to all and should be utilized in a judicious manner.

Almost half a million women die every year from complications during pregnancy and child birth. Every day, approximately 830 women die from preventable causes related to pregnancy and child birth. About 99% of these women are from developing world, concentrated in Africa and Asia. Top countries where maternal mortality is less than ten are Austria, Sweden, Japan, Spain, Switzerland, Israel, Kuwait, Poland, Iceland, Greece etc.

The maternal mortality ratio has reduced in India from 254 in 2004-2006 to 212 in 2007-2009 and to 178 in 2010-2012, and 167/100000 live births in 2011-2013 Kerala's health indicators have been consistently better than national Indian average, due to high literacy, better road networks and a large number of health facilities. However MMR in Kerala has remained almost static in the last couple of decades. The sample registration system reported the MMR for Kerala in the period 2004-06 as 95 2007-2009 as 81 2010-12 as 66 and 2011-13 as 61 per 100000 live births. (Source sample registration system Registrar General of India).

In the United Kingdom these categories of death are notified through UK Confidential Enquiry into Maternal Deaths (CEMD) which started in one region in 1921 and became nationwide in 1951, collates all information and reports them every three years. The purpose of the confidential enquiry is not simply to establish a basic cause of death, but to reach an understanding as far as possible of all the circumstances surrounding it. The Kerala Federation of Obstetrician and Gynaecology (KFOG) choose to conduct a Confidential Enquiry into Maternal Deaths in tune with UK CEMD from 2004<sup>4</sup>.

There is global lack of autopsy related data leading to the circumstances of maternal death in developing countries. Most deliveries and deaths occur in rural areas, where there are no facilities in hospitals to tackle obstetric emergency, or lack of obstetricians, and proper transport system. Autopsy is an important tool in the investigation of maternal death. It provides valuable information about pathophysiological changes in various organs, which may be important in the delineation of the sequence of events leading to maternal death. The outcome requires clinical data, pathological and microbiological investigation, information from investigation officer, and relatives.

**Materials And Methods:-**

Sixty five cases of maternal death which undergone medico legal autopsy during 1-1-1995 to April 2003 at Department of Forensic Medicine, Government Medical College Thiruvananthapuram, Kerala were included, after obtaining approval from Institutional Review Board. Maternal death due to pregnancy or within 42 days of termination of pregnancy, irrespective of duration and site of pregnancy are included. The factors that lead to

medico legal autopsy in maternal deaths were cases referred from peripheral hospitals, remote areas, brought dead obstetric cases, allegation of negligence by the next of kin of the deceased regarding the management of pregnancy, delivery, accidental and incidental cases. The objectives of medico legal autopsy were strictly adhered to while conducting postmortem examination. Data for each case were collected by closed questionnaire prepared for this purpose. In all cases clinical case records if available were perused. Postmortem detailed notes of medico legal autopsy in maternal death cases from 1-1-1995 to 2000 were perused retrospectively and entered in the proforma. Maternal death cases during the period from 2001 to April 2003 were studied prospectively. Relevant information from investigating officers, relatives of deceased were also collected prior to autopsy.

During autopsy external features, postmortem changes, injuries i.e. surgical and non-surgical, needle puncture marks, episiotomy wound, LSCS sutures etc., were carefully noted and recorded. All internal organs were inspected and dissected in detail. The abdominal and pelvic cavities were inspected carefully to allow clear demonstration of anatomy and injuries if any to pelvic vessel, broad ligament, uterus cervix and upper vagina. The placenta if present and left attached to the uterine wall were inspected. Site of attachment of placenta was recorded and the same was subjected to histopathology study to find out retro placental haemorrhages and infarction. Retained products of conception, placenta accreta, increta, percreta, and couvelaire uterus etc. if present were noted and recorded. Histopathology of all organs, chemical examination of viscera, blood and urine, and swab from infected lesions were sent for microbiology examination.

The collected data were subjected to analysis using Statistical Package for Social Sciences (SPSS).

### **Observation And Results:-**

Sixty five cases of maternal death which underwent medico legal autopsy during 1995 to April 2003 were analyzed. The year wise break up of cases and their percentage are given in **table 1**. Highest number of cases were during 2001, 13 cases (20%) and least in 1995, 5 cases (7.9%).

Maximum number of maternal deaths were in the age group between 25-29 years, 31 cases (47.7%) and minimum number below 20 years, 2 cases (3.1%). The eldest mother was 48 years and youngest 18 years old. The age wise distribution of maternal death is shown in **table no.2**

Thirty eight maternal deaths were in primigravida (58.5%), 22 cases were in second gravida (33.8%) and there was one fifth gravida. There was no history of abortion in 94% cases and 6.2% cases had previous history of abortion. Of the maternal death analyzed 58 cases i.e. 90% had normal conception and the 7 cases were ectopic pregnancy (10.7%). Based on the phase of pregnancy they were categorized into antenatal, intranatal, postnatal and post aborted deaths. Maximum maternal deaths were during postnatal phase 32 cases, which accounted for 49%. The accompanying **table no.3** show the distribution of cases based on the phase of pregnancy.

Analyzing the type of delivery maximum maternal deaths i.e. 24 (38.5%) were the result of caesarian section and its complications, followed by 12 (18.5%) normal delivery.

### **Causes Of Maternal Deaths:-**

The causes of maternal deaths, were analysed. Direct causes were observed in 39 cases (60%), indirect maternal death in 24 cases (36.9%) and no definite causes could be attributed in 2 cases (3%). Causes of maternal deaths and their percentage are shown in **table no.4**.

### **Direct Maternal Deaths:-**

Out of thirty-nine cases of maternal deaths, the most common direct cause detected in the present study was haemorrhages, 15 cases (23.07%) followed by ruptured ectopic pregnancy 7 cases (10.8%), complication following caesarian section 4 cases (6.2%), anesthetic death, abortion, pregnancy induced hypertension, rupture uterus, accounted for 2 cases each (3.1%), endometritis, septicaemia, placenta increta, MTP, its complications, and injury to intestine, 1 each (1.6%). The causes of direct maternal deaths are enlisted in the **table no.5**.

Postpartum haemorrhage was the leading cause in 12 cases, followed by 3 cases of ante partum haemorrhage. Among the postpartum haemorrhage three were due to injury sustained to the cervix and vagina during delivery, in 5 cases following lower segment caesarian section and in 4 cases it was after full term normal delivery.

Regarding ante partum haemorrhage, in two cases deaths were attributed to premature separation of placenta, following fall at 25<sup>th</sup> week, the second case was an elderly primi with history of fall at 28<sup>th</sup> week of pregnancy and tear of broad ligament. The third case was that of a 48 year old woman being the eldest in the study group and third gravida who had premature separation of placenta at 32 weeks of pregnancy.

Ruptured ectopic pregnancy was attributed to the cause of direct maternal death in seven cases, of which six were in primigravida and the other was second gravida. In all cases rupture site was at ampulla of fallopian tube, with 500 to 1800ml blood collected in abdominal cavity. All the cases of ectopic pregnancy were referred from peripheral hospitals either in terminal shock stage or as brought dead to Gov. Medical College, Thiruvananthapuram.

Complications following lower segment caesarian section were the cause of death in four cases. Shock, acute tubular necrosis, peritonitis, septicemia and oedema of larynx were observed as complications.

In two cases administration of anesthesia and its complication was directly attributed to death, it includes respiratory failure following intravenous administration of fortwin and calmpose.

Abortion and its complication were attributed as the cause of death in two cases, disseminated intravascular coagulation and endometritis were the complications.

In two cases of direct maternal deaths due to pregnancy induced hypertension at 36<sup>th</sup> week .In one case caesarian section was done due to foetal distress, fatty liver and acute tubular necrosis, venous congestion of liver and renal artery calcification and adrenal haemorrhage were present in another case.

Uterine rupture was seen in two second gravida who had previous caesarian section, rupture occurred at 36<sup>th</sup> week of pregnancy .In one case there was history of fall one week prior to death. Both cases there was massive intraperitoneal bleeding. In a third, gravida death was due to endometritis after full term normal delivery. Primigravida with rheumatic heart disease, who underwent lower segment caesarian section, had renal failure with septicaemia was attributed to cause of death on the fourth postoperative day.

Placenta increta, a rare condition was seen in a second gravida with history of previous caesarian section. Histopathology examination uterus showed areas of haemorrhage, congested vessels and invasion of uterine wall by chorionic villi. Death following medical termination of pregnancy was the cause in one case with evidence of coagulation failure. Injury to intestine following caesarian section was the cause of death in another, here on the fourth postoperative day patient developed leak from anastomotic site leading to peritonitis and death.

Underlying anaemia, infections, malnutrition, instrumentation and trauma sustained during delivery, lack of transfusion facilities, non availability of blood and delay in obtaining tertiary referral services, might have been the contributing factors in direct maternal deaths due to haemorrhage.

The factors which lead to haemorrhage as the leading direct cause of maternal death observed during the present study and their percentage are given in the **table no.6**

**Table No 1:-** Year Wise Distribution And Percentage Of Maternal Deaths.

Year	Maternal death cases	Percentage
1995	5	7.9
1996	9	13.84
1997	8	12.30
1998	6	9.23
1999	5	7.90
2000	10	15.38
2001	13	20.00
2002	6	9.23
2003 Jan-April	3	4.8
Total	65	100

**Table No.2:-**The Age Wise Distribution Of Maternal Deaths.

Age group	Number of cases	Percentage
< 20	2	3.1
20 -24	16	23.1
25-29	31	47.7
30-34	11	16.9
> 35	6	9.2
Total	65	100

**Table 3:-** Distribution Of Maternal Deaths Based On Phase Of Pregnancy.

Phase of Pregnancy	Number of cases	Percentage
1.Antenatal	27	41.5
2.Intranatal	04	06.2
3.Post natal	32	49.2
4.Post abortal	02	03.1

**Table No 4:-** Causes Of Maternal Deaths And Their Percentage.

Causes	Number of cases	Percentage
Direct maternal deaths	39	60
Indirect maternal deaths	24	37
Undetected deaths	02	3

**Table No.5:-** Causes Of Direct Maternal Deaths.

Sl no	Causes of Direct maternal deaths	Number of cases	Percentage
1	Haemorrhage	15	23.07
2	Ruptured ectopic pregnancy	7	10.08
3	Following LSCS.	4	6.2
4	Anesthetic deaths	2	3.1
5	Abortion	2	3.1
6	Pregnancy induced hypertension	2	3.1
7	Ruptured uterus	2	3.1
8	Endometritis	1	1.6
9	.Septicaemia	1	1.6
10	Placenta increta	1	1.6
11	.Following MTP	1	1.6
12	.Injury to intestine	1	1.6
	Total	39	60

**Table No.6:-** Factors Which Lead To Haemorrhage As Direct Maternal Deaths

Sl no	Factors leading to haemorrhage	Percentage
<b>I</b>	<b>Post-partum haemorrhage</b>	<b>18.46</b>
a)	Traumatic	04.60
b)	During LSCS	07.70
c)	Following full term normal delivery	06.20
<b>II</b>	<b>Antepartum haemorrhage</b>	<b>04.80</b>
a)	Abruption ( Traumatic)	01.60
b)	Tear of broad ligament	01.60
c)	Premature separation of placenta	01.60
	<b>Total</b>	<b>23.07</b>

**Table No.7:-** Comparison Of Studies In India Regarding Maternal Deaths. ( Results expressed as percentage)

Author	Period of study	Direct causes	Indirect causes	Coincidental causes
Kavatkar et al	1993-2000	49.5	34.7	15.8
Panchabhaietal	1998-2006	48.3	51.7	---
Kulkarnietal	2009-2014	73.11	24.84	02
Vasaikar et al	2008-2012	50.9	47.3	01.8
Present study	1995- 2003	60	37	03

**Discussion:-**

The mean Maternal Mortality Ratio during 2001 to 2003 was 110/100000 live births in Kerala.

In the present study 47.7% maternal deaths were in the age group of 25-29 years, 58.5% were primigravida, and direct causes accounted for 60% of the deaths. Among the direct causes of maternal deaths 15 cases (23.07%) were due to haemorrhage of which 12 cases (18.46%) were due to postpartum and 3 cases (4.80%) were due to ante partum haemorrhage.

A 10-year retrospective study of all maternal deaths from January 01, 2005 to December 31, 2014 at Lagos State University Teaching Hospital which is the only state-owned tertiary center and the main referral center in Lagos State. Here records were taken from the death register and other information were extracted from the postmortem reports. Most maternal deaths 98/328 (29.9%) were seen in the age group 26–30 years which was followed by 31–35 years (24.7%). Direct causes accounted for 60% of maternal deaths with postpartum hemorrhage<sup>5</sup>. Regarding direct death as the leading cause, age of the deceased and post-partum haemorrhages, are in concurrence with the present study

A descriptive, retrospective review of the postmortem autopsy findings from cases of maternal death at the Obafemi Awolowo University Teaching Hospitals Complex, Ile-Ife, Nigeria over a 5-year period. A total of 84 cases of maternal deaths were used for the study<sup>6</sup>. 71.4% of the maternal deaths were due to direct causes and 28.6% were due to indirect causes. The mean age at the time of death was 27.9±7.5 years. Overall, the three leading causes of death were obstetric hemorrhage (30.9%), complications of abortion (23.8%), and nongenital (nonobstetric) infections (14.2%). Of the direct causes of maternal death, obstetric hemorrhage (43.3%) was the leading, with postpartum hemorrhage accounting for most (65.0%) of such deaths; other causes included complications of unsafe induced abortion (33.3%) and of labor (11.7%).

According to M. Badarinath and Saraswathi, Maternal mortality, a retrospective study from January 2009 to March 2014, 72.5% cases of maternal deaths were due to direct causes, 46% deaths were in the age group of 21-25 years and 51.11% were primigravida, Haemorrhage, eclampsia (26.6%) and sepsis (18.33%) were the leading causes<sup>7</sup>. Regarding the direct causes and haemorrhages as the prime factor leading to of maternal deaths, our observation is in close association with the above study.

Clinico-pathological co-relation of maternal deaths in a tertiary care centre, Southern Maharashtra, a retrospective pathological autopsy study during January 2009 to June 2014 by Kulkarni A.M. Chaudhari A.A. Jadhav N.S, 73.11% deaths were direct maternal deaths, of which haemorrhages was prime cause (31.18%), followed by preeclampsia eclampsia (15.5%), intrauterine death (16.12%), puerperal sepsis (3.22%), retained placenta (4.30%), uterine rupture (2.15%), uterine inversion (1.07%)<sup>8</sup>. Direct causes as the most important factor and of which haemorrhage was the leading cause, pregnancy induced hypertension uterine rupture (3.1%) and puerperal sepsis (1.6%) were also the causes of direct deaths in the present study.

Autopsy study of maternal deaths by Kavatkar AN, Sahasrabudhe NS, Jadhav MV, Desmukh SD, out of 95 cases were autopsied 49.5% were direct maternal death, hypertensive disorders associated with pregnancy (24.2%) and anaemia (14.7%) were most common. In the hypertensive group, important findings were disseminated intravascular coagulation, haemorrhages and thromboemboli<sup>7</sup>.

A retrospective autopsy study of all cases of maternal deaths that underwent a pathological autopsy in a tertiary health centre from January 1998 to December 2006 by TS Panchabhai, P.D. Patil, DR Shah, AS Joshi 277 cases were autopsied<sup>8</sup>. In the autopsy cases most common cases of maternal mortality were due to direct causes, among them

prime causes were pre eclampsia eclampsia ( 40/277, 14.44%) and haemorrhage ( 32 /277, 11.55%) Of the 40 cases of pre eclampsiaeclampsia on autopsy , 17 had evidence of disseminated intravascular coagulation whilehaemolysis, elevated liver enzymes ( HELLP syndrome) was seen in 10 cases. Direct maternal death were the most common cause among autopsied cases which is in accordance with our study, preeclampsia , eclampsia as the leading cause is not matching with our observation , and there is not much difference between haemorrhage.

Pregnancy related deaths, a three year retrospective study by Bardale, Dixit, during 2004- 2006 , based on death records, total of 21 pregnancy related deaths occurring during 2004 to 2006 were autopsied<sup>9</sup>. The age group ranged from 21 to 35 years with mean age of 26.47 year. Maximum numbers of deaths were recorded in the age group of 21-25 years (52.38%). Haemorrhage remained the leading cause (38.09%) ,of which rupture uterus,retained placenta, and DIC were the contributing factors . Others included sepsis,postpartum eclamptic shock and undetermined causes. In the present study the maternal age ranged from 18 to 48 years, and most death were between 25 to 29 years (47.7%) the age parameters are not agreeing with the above study.

The **table no.7** compares the results of similar studies and the present study regarding causes of maternal deaths in India.

The Confidential Review of Maternal Deaths (CMRD) in Kerala was started in 2004, the leading causes of maternal deaths identified during the period 2004-09 were haemorrhages( 22.5%), and pregnancy induced hypertension (15.6%) followed by amniotic fluid embolism, heart disease and sepsis<sup>2</sup>. Here also haemorrhage was the leading cause of direct maternal death, which is in conformity with our study.

Rupture of ectopic pregnancy followed by bleeding accounted for 7 cases of direct maternal deaths ( 10.08%) in the present study, but this as a cause of direct maternal death was not observed in the above cited studies. In the confidential enquiry into causes of maternal death (1988-1990), 10.30% were due to ruptured ectopic pregnancy, which is in association with present observation.

In a study on sudden death and ectopic pregnancy mortality, by Anderson FW, Hogan JG, Ansbacher R, of the 268 pregnancy-related deaths, 16 (6%) were caused by complications of ectopic pregnancy. Mean age at death was 27 (+/- 6) years. Thirteen deaths were to African-American women and 3 were to white women (P < .01). African-American women had an ectopic mortality ratio 18 times higher than white women (3.25/100,000 live births, compared with 0.18/100,000)<sup>10</sup>

### Summary:-

Sixty five maternal deaths brought for medicolegal autopsy to Department of Forensic Medicine , Gov. Medical College, Thiruvananthapuram, during 1995 to 2003 April were included in this study . In majority of cases autopsy examination was conducted due to allegation of medical negligence against doctors and hospital authorities for lack of adequate obstetric care. More than 80% cases were referred cases from peripheral health care centres either in terminal stage to the tertiary center and as brought dead cases.

- ❖ Maximum number of maternal deaths were in 2001 and 2002, during the above period there were ten and thirteen maternal deaths brought for autopsy respectively.
- ❖ The predominant maternal age was between 25-29 years( 47.7%) and 38 cases were primigravida ( 58.5%)
- ❖ Direct maternal deaths were the leading cause ( 39cases, 60%), followed by indirect deaths( 24 cases,36.9%) and undetermined ( 2 cases,3.1%)
- ❖ Haemorrhage (15 cases,23.07%)was the predominant direct cause of death, of which postpartum haemorrhage ( 12 cases, 18.46%) and antepartum haemorrhage ( 3cases, 4.8%).
- ❖ Haemorrhages as the leading direct cause was observed in similar studies on maternal death quoted above.
- ❖ Deaths due to ruptured ectopic pregnancy (7cases10.08%) and following caesarean section ( 4cases, 6.2%) were unique findings in the present study which are not mentioned in similar studies cited.

### Suggestions and Conclusions:-

Maternal death is a measure of quality of health care in a community. Though the risk of death from complications of pregnancy has decreased during the past few decades in India, it continues to remain higher in developing countries.

Direct maternal deaths due to hemorrhage was the prime cause in the present study.

The following interventions are needed to prevent deaths due to hemorrhage viz. active management of third stage of labour, observe fourth stage systematically, to tackle hypotension due to blood loss, use blood and blood products, women who need blood transfusion must be observed in intensive care units for at least 24 hrs.

Placenta praevia/ accrete/increta should be ruled out, or identified, by routine scan at 32 weeks of gestation for all women who had previous caesarean section and if found to have any of the conditions above should be referred to higher center.

Regular death audit meetings and mortality conferences including obstetricians, forensic pathologist, pathologist, anesthetists at institutional level create awareness regarding causes and avoid ability of the maternal deaths.

Maternal mortality rates are an index of the state of a nation's health system. Maternal autopsies help to determine these rates, provide information on avoidable/unavoidable causes of mortality, consequently leading to the development of strategies for treatment and prevention of maternal mortality and morbidity. The lesson from post-mortem examinations, using the vehicle of confidential enquiries into maternal deaths, can save the lives of many; causing reduction in both maternal and perinatal mortality as well as reductions in morbidity<sup>11</sup>. However, for autopsies to fulfill this role they must be of a very high standard and must be subjected to quality control measures. Encouraging hospital autopsy with histopathology and microbiology examination in all maternal deaths will help in understanding the cause of death, particularly preventable ones.

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