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Uma Munnur
Dilip R. Karnad
Venkata D. P. Bandi
Vijay Lapsia
Maya S. Suresh
Priya Ramshesh
Michael A. Gardner
Stephen Longmire
Kalpalatha K. Guntupalli

Critically ill obstetric patients in an American and an Indian public hospital: comparison of case-mix, organ dysfunction, intensive care requirements, and outcomes

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U. Munnur · M. S. Suresh · M. A. Gardner · S. Longmire
Department of Anesthesiology and Obstetrics, Baylor College of Medicine, Ben Taub General Hospital, Houston, TX, USA

D. R. Karnad (✉) · V. Lapsia · P. Ramshesh
Department of Medicine, Medical-Neuro Intensive Care Unit, King Edward Memorial Hospital, 400012 Parel, Mumbai, India
e-mail: karnad@vsnl.net
Tel.: +91-22-24136051

V. D. P. Bandi · K. K. Guntupalli
Department Of Medicine, Pulmonary and Critical Care Section, Baylor College of Medicine, Ben Taub General Hospital, Houston, TX, USA

Abstract *Objective:* To compare case-mix, health care practices, and outcome in obstetric ICU admissions in inner-city teaching hospitals in economically developed and developing countries. *Design:* Retrospective study. *Setting:* Ben Taub General Hospital (BTGH), Houston, Texas, and King Edward Memorial Hospital (KEMH), Mumbai, India. *Patients:* Women admitted during pregnancy or 6 weeks postpartum between 1992 and 2001. *Measurements and results:* Patients from BTGH (n=174) and KEMH (n=754) had comparable age, number of organs affected, incidence of medical disorders (30%), liver dysfunction, and thrombocytopenia. Fewer KEMH patients received prenatal care (27 vs 86%) and came to hospital within 24 h of onset of symptoms (60 vs 90%). They had higher APACHE II scores (median 16 vs 10), greater incidence of neurological (63 vs 36%), renal (50 vs 37%), and cardiovascular dysfunction (39 vs 29%). Severe malaria, viral hepatitis, cerebral venous thrombosis, and poisoning were common medical disorders. The BTGH group had higher incidence of respiratory dysfunction (59 vs 46%) and disseminated intravascular coagulation (40 vs 23%), placental anomalies, HELLP syndrome, chorioamnionitis, peripartum cardiomyopathy, puerperal sepsis, urinary infection, bacteremia, substance abuse, and asthma. More BTGH patients required mechanical ventilation and blood component therapy, whereas more KEMH patients needed dialysis. Of BTGH patients, 78.2% were delivered by cesarean section (vs 15.4%). Maternal (2.3 vs 25%) and fetal (13 vs 51%) mortality were lower in BTGH patients. *Conclusions:* There were marked differences in medical diseases, organ failure, and intensive care needs. Higher mortality in the Indian ICU may be due to difference in case mix, inadequate prenatal care, delay in reaching hospital, and greater severity of illness.

Keywords Pregnancy · Critical illness · Puerperium · Near-miss maternal mortality · Maternal health · Developing countries · Tropical diseases · Antenatal care · Intensive care unit

Introduction

Maternal mortality in the United States, Canada, and Europe has declined progressively [1, 2, 3, 4] but continues to remain very high in developing countries. Maternal mortality in India is 440 per 100,000 deliveries compared to 12 per 100,000 deliveries in the United States and 6 in Canada [4]. Although obstetric patients form a significant proportion of ICU admissions in developing countries [5, 6], there are only a very few studies from these countries reporting on critical illness in pregnancy [7, 8, 9], and none comparing the acute disorders

leading to critical illness in obstetric patients with those in economically developed countries. Besides case mix, ethnicity and differences in health care system may affect the spectrum of life-threatening obstetric and medical disorders seen in pregnancy. International comparisons can also identify treatments which may result in improved maternal or fetal outcome. We therefore studied obstetric patients admitted to the medical ICU of an Indian public hospital with those admitted to a county hospital in the U.S.

For the year 2002, the annual per capita health care expenditure in the U.S. was $4499, whereas that in India was US$71 when adjusted for purchasing power parity [10, 11]. Despite this, a significant proportion of non-white Americans lack easy access to, or underutilize, health care facilities [12]. Racial disparity in maternal mortality in the U.S. has been as high as 300–400% [4, 13], especially in counties with a high proportion of minority population [14]. We therefore selected a publicly funded county hospital in Houston (Texas), a city with a population which is 30.8% white American, 25% African American, 37.4% Hispanic, and 6.8% Asian [15], and a public hospital in Mumbai, India, for this study.

Patients and methods

The Hospitals

The Ben Taub General Hospital (BTGH) is one of two county hospitals in Houston, Texas, and is a referral center for high-risk obstetrics. About 6000 deliveries are conducted annually at this 537-bed hospital. Patients with a predominant obstetric disorder were admitted to the one-bed obstetric ICU located adjacent to the obstetric operation suite, and were jointly managed by obstetricians and obstetric anesthesiologists in consultation with the medical ICU (MICU). Postpartum patients requiring ICU care and patients with co-existing medical conditions were transferred to the MICU or admitted directly to the 16-bed MICU, a closed ICU with approximately 1200 admissions annually, staffed by an intensivist, a critical care fellow, three internal medicine residents and three internal medicine interns. Obstetric patients account for 1.5% of these admissions.

The King Edward Memorial Hospital (KEMH) is a municipally funded 1800-bed university hospital. It is one of four tertiary referral centers for obstetric patients from public hospitals and maternity homes in Mumbai and conducts about 5500 deliveries annually. The multidisciplinary ICU is a closed unit with 17 beds and receives about 1100 admissions annually; 7% of these are obstetric patients. Critically ill pregnant women with obstetric or co-existing medical conditions are transferred to the ICU and are jointly managed by a team of two attending intensivists, five ICU residents, an obstetric resident, and a junior obstetric attending. The ICU also admits patients from the 320 bed Nowrosjee Wadia Maternity Hospital located nearby. This hospital conducts about 10,000 deliveries annually, has only obstetric, gynecology, and neonatology services, and utilizes the facilities at the KEMH for care of non-obstetric co-morbid conditions. Diagnostic facilities available at BTGH and KEMH were comparable.

Patients

Medical records of all women admitted to the ICUs during pregnancy or within 6 weeks of delivery during the 10-year period 1992–2001 were retrospectively analyzed. Day-1 APACHE II score was recorded to assess severity of illness. The reason for ICU admission was classified into obstetric, if it was a direct consequence of the pregnant or postpartum state (e.g., placenta previa, pre-eclampsia, postpartum hemorrhage), and medical, if it could have occurred even in a non-pregnant state (e.g., pyelonephritis, deep vein thrombosis, auto-immune disorders). Organ dysfunction was assessed daily using the Multiple Organ Dysfunction Score (MODS) criteria [16]. The MODS criteria assess respiratory dysfunction using the ratio of arterial pO_2/fraction of inspired oxygen, renal dysfunction by the serum creatinine level, hepatic dysfunction by serum bilirubin level, neurological dysfunction by the Glasgow coma scale, hematological dysfunction by the platelet count, and cardiovascular dysfunction by arterial blood pressure and heart rate [16]. Scores assigned to individual organs were added to give the MODS score.

Intensive care requirements, such as mechanical ventilation, packed red cell transfusion, blood products, inotropic or vasopressor drugs, and dialysis, were recorded. Obstetric interventions performed were also recorded. Intra-uterine fetal death was defined as fetal death at admission. Uterine and pelvic infection occurring prior to delivery was considered as chorioamnionitis, whereas that occurring after delivery or abortion was considered as puerperal sepsis. Primary bacteremia was defined as clinical manifestations of sepsis with positive blood culture in the absence of any pulmonary, urinary, abdominal, or uterine source of infection.

Outcome measures noted included length of ICU stay as well as maternal and fetal survival at discharge from hospital.

Statistical methods

Differences between the two hospitals were compared using the *t*-test, Mann-Whitney U-test, chi-squared test, or Fisher's exact test as appropriate. A p value of <0.05 was considered statistically significant.

Results

During the 10-year study period, 58,000 deliveries took place at the BTGH and 157,694 at the KEMH and Wadia Hospital; of these, 174 patients at BTGH (300 per 100,000 deliveries) and 754 patients at KEMH (478 per 100,000 deliveries) required admission to the Medical ICU. Patients from both hospitals were of comparable age (Table 1). Indian patients presented earlier in pregnancy (mean 30.6 vs 32.8 weeks) and were sicker as assessed by the APACHE II score (Table 1). About 22% of BTGH patients and 11% of KEMH women had been pregnant four or more times (OR=2.2, 95% CI 1.4–3.4). Ninety percent of BTGH patients were admitted within the first 24 h of onset of the acute symptoms (Table 1), as compared with 60% of KEMH patients (OR=6.1, 95% CI: 3.5–10.6). This interval was comparable for KEMH and Nowrosjee Wadia Maternity Hospital patients.

Among the 928 critically ill obstetric patients, altered mental status was the commonest presenting manifestation and was seen in 416 (44.8%) patients, followed by

Table 1 Demographic characteristics and presenting manifestations in 754 obstetric admissions in the ICU from King Edward Memorial Hospital Hospital, Mumbai, India, and 174 patients from Ben Taub General Hospital, Houston, Texas

Variable		King Edward Memorial Hospital (*n*=754)	Ben Taub General Hospital (*n*=174)	Odds ratio (95% CI)
Age (years)		25.4+4.6	26.1+7.3	–[b]
Receiving prenatal care[a]		202 (26.8%)	150 (86.2%)	0.06 (0.04–0.09)[b]
No. of pregnancies	≤3	669 (88.7%)	136 (78.2%)	1.75 (1.05–2.9)[b]
	>3	85 (11.3%)	38 (21.8%)	
Interval between onset and admission	≤1 day			
	>1 day	454 (60.2%)	157 (90.2%)	0.16 (0.09–0.28)[b]
		299 (39.8%)	17 (9.8%)	
Gestational age (weeks)		30.6+6.9	32.8 + 6.5	–[b]
Day 1: APACHE II score		16 (10–24) (range 1–55)	10 (7–13) (range 3–27)	–[b]
Presenting manifestations				
Bleeding		301 (39.9%)	92 (52.9%)	0.59 (0.42–0.84)[b]
Fever		204 (27.1%)	96 (55.2%)	0.30 (0.21–0.43)[b]
Jaundice		160 (21.2%)	34 (19.5%)	1.11 (0.72–1.71)
Shortness of breath		177 (23.5%)	76 (43.7%)	0.31 (0.22–0.47)[b]
Seizures		228 (30.2%)	8 (4.6%)	9.1 (4.26–20.3)[b]
Altered mental status		379 (50.3%)	37 (21.3%)	3.74 (2.49–5.64)[b]

[a] Patients with at least two prenatal visits were classified as receiving prenatal care
[b] Difference was statistically significant ($p<0.05$)

Table 2 Obstetric conditions requiring ICU admission in 928 obstetric patients, admitted to the intensive care units of King Edward Memorial Hospital, Mumbai, India, and Ben Taub General Hospital, Houston, Texas

Obstetric disorder	King Edward Memorial Hospital (*n*=754)	Ben Taub General Hospital (*n*=174)	Odds ratio (95% CI)
Pre-eclampsia/eclampsia	343 (45.5%)	74 (42.5%)	1.13 (0.80–1.6)
Postpartum hemorrhage	115 (15.3%)	32 (18.4%)	0.8 (0.51–1.26)
IUFD	94 (12.5%)	8 (4.6%)	2.96 (1.36–6.7)[a]
Post-abortal/puerperal sepsis	49 (6.5%)	26 (14.9%)	0.38 (0.22–0.66)[a]
HELLP syndrome	42 (5.6%)	31 (17.8%)	0.27 (0.16–0.46)[a]
Abruptio placentae	43 (5.7%)	15 (8.6%)	0.64 (0.34–1.24)
Acute fatty liver of pregnancy	33 (4.4%)	3 (1.7%)	2.61 (0.76–10.8)
Antepartum hemorrhage	27 (3.6%)	4 (2.3%)	1.58 (0.52–5.39)
Chorioamnionitis	7 (0.9%)	22 (12.6%)	0.06 (0.02–0.16)[a]
Abortions	18 (2.4%)	6 (3.5%)	0.68 (0.25–1.96)
Abnormal adherence of placenta	8 (1.1%)	9 (5.2%)	0.2 (0.07–0.56)[a]
Peripartum cardiomyopathy	4 (0.5%)	10 (5.8%)	0.09 (0.03–0.29)[a]
Uterine rupture	6 (0.8%)	3 (1.7%)	0.46 (0.1–2.33)
Amniotic fluid embolism	4 (0.5%)	1 (0.5%)	0.92 (0.1–21.8)

[a] Difference was statistically significant ($p<0.05$)

bleeding in 393 (42.4%), fever in 300 (32.3%), shortness of breath in 253 (27.3%), seizures in 236 (25.4%), and jaundice in 194 (20.9%) patients. Fever, shortness of breath, and bleeding were significantly more frequent in BTGH patients, whereas altered mental status and convulsive seizures were more common in Indian patients (Table 1).

Organ dysfunction and therapeutic interventions

Respiratory and hematological dysfunction and DIC were more common in American (BTGH) patients (Table 2), and mechanical ventilation, packed red cell transfusion, and blood products were used more frequently in this group (Table 3). On the other hand, neurological, renal, and cardiovascular dysfunction was more common in Indian (KEMH) patients and more Indian patients required dialysis (Table 3). Hepatic involvement was similar in both groups. Although the MODS score on admission was similar in the two groups, Indian ICU patients had a higher maximum MODS score (Table 2). All obstetric interventions, including induction of labor, cesarean section, and cesarean hysterectomy, were performed more frequently in American patients than in Indian patients (Table 3).

Etiology of organ dysfunction

Of the 928 patients, obstetric disorders were the commonest indications for admission to the ICU and were

Table 3 Medical disorders requiring ICU in admission in 928 obstetric patients admitted to the intensive care units of King Edward Memorial Hospital, Mumbai, and Ben Taub General Hospital, Houston, Texas

Medical disorders	King Edward Memorial Hospital (*n*=754)	Ben Taub General Hospital (*n*=174)	Odds ratio (95% CI)
Community-acquired pneumonia	23 (3.1%)	5 (2.9%)	1.06 (0.38–3.24)
Urinary tract infection	2 (0.3%)	18 (10.3%)	0.02 (0.00–0.10)[a]
Malaria	75 (10.0%)	0	38.8 (2.26–665)[a]
Hematological disorder	12 (1.6%)	1 (0.6%)	2.8 (0.38–58.0)
Congenital heart disease	2 (0.3%)	2 (1.2%)	0.23 (0.02–2.28)
Rheumatic heart disease	16 (2.1%)	2 (1.2%)	1.86 (0.41–11.9)
Aspiration pneumonia	23 (3.1%)	6 (3.5%)	0.88 (0.33–2.45)
Diabetes mellitus	16 (2.1%)	4 (2.3%)	0.92 (0.28–3.30)
Chronic renal failure	4 (0.5%)	1 (0.6%)	0.92 (0.10–21.8)
Trauma	0	1 (0.6%)	0.0 (0.0–3.8)
Drug abuse	0	5 (2.9%)	0.0 (0.0–0.26)[a]
Rheumatological disorders	2 (0.3%)	2 (1.2%)	0.23 (0.02–2.28)
Anaphylaxis	0	2 (1.2%)	0.0 (0.0–0.93)[a]
Asthma	1 (0.1%)	5 (2.9%)	0.04 (0.0–0.4)[a]
DVT/pulmonary embolism	5 (0.7%)	2 (1.2%)	0.57 (0.1–4.3)
Malignancy	1 (0.1%)	6 (3.5%)	0.4 (0.0–0.31)[a]
Acute abdomen	6 (0.8%)	10 (5.7%)	0.13 (0.04–0.40)[a]
CNS infection	6 (0.8%)	0	3.03 (0.16–57.3)
Viral hepatitis	47 (6.2%)	0	23.4 (1.36–404)[a]
Bacteremia	13 (1.7%)	8 (4.6%)	0.36 (0.14–0.98)[a]
Attempted suicide (poisoning/drug overdose)	13 (1.7%)	1 (0.6%)	3.0 (0.41–62.6)
Transfusion reaction	2 (0.3%)	1 (0.6%)	0.46 (0.03–12.9)
Cardiac arrest prior to ICU admission	21 (2.8%)	1 (0.6%)	4.96 (0.70–99.7)[a]
Endocrine	8 (1.1%)	1 (0.6%)	1.86 (0.23–39.8)
Arterial disease	1 (0.1%)	1 (0.6%)	0.23 (0.01–8.43)
Intracranial hemorrhage	9 (1.2%)	1 (0.6%)	2.09 (0.27–44.3)
Cerebral venous thrombosis	26 (3.5%)	0	12.7 (0.73–221)[a]
Tetanus	2 (0.3%)	0	1.16 (0.05–25.8)
Typhoid	1 (0.1%)	0	0.69 (0.02–18.3)
Leptospirosis	2 (0.3%)	0	1.16 (0.05–25.8)
Cerebral infarction	2 (0.3%)	0	1.16 (0.05–25.8)

[a] Difference was statistically significant ($p<0.05$)

Table 4 Organ involvement as defined by the Multiple Organ Dysfunction Score (*MODS;* from [16]) in 928 obstetric patients admitted to the ICUs of King Edward Memorial Hospital, Mumbai, India, and Ben Taub General Hospital, Houston, Texas

	King Edward Memorial Hospital (*n*=754)	Ben Taub General Hospital (*n*=174)	Odds ratio (95% CI)
Organ dysfunction			
Neurological	477 (63.3%)	63 (36.2%)	3.03 (2.12–4.34)[b]
Cardiovascular	290 (38.5%)	50 (28.7%)	1.55 (1.07–2.26)[b]
Hepatic	274 (36.3%)	72 (41.4%)	0.81 (0.57–1.15)
Renal	373 (49.5%)	64 (36.8%)	1.68 (1.18–2.4)[b]
Hematological	420 (55.7%)	109 (62.6%)	0.75 (0.53–1.07)
Respiratory	345 (45.8%)	102 (58.6%)	0.66 (0.42–0.84)[b]
Disseminated intravascular coagulation[a]	172 (22.8%)	70 (40.2%)	0.44 (0.31–0.63)[b]
MODS scores			
MODS score on admission	4 (2–5) (range 0–12)	3 (2–5) (range 0–16)	–
Maximum MODS score	5 (3–7) range (0–16)	4 (2–6) range (0–22)	–[b]

[a] Disseminated intravascular coagulation is not a part of MODS
[b] Difference was statistically significant ($p<0.05$)

present in 68% of all admissions. The most common diagnosis in patients from both hospitals was pre-eclampsia/eclampsia (Table 4), which was seen in 417 (44.9%) patients. The HELLP syndrome, puerperal sepsis, placental anomalies, and peripartum cardiomyopathy were more common in American ICU patients, whereas intrauterine fetal death was more common in Indian patients. Other abnormalities were equally common in both hospitals.

Table 5 Medical and obstetric therapeutic interventions performed in 928 obstetric patients admitted to the ICUs of King Edward Memorial Hospital, Mumbai, India, and Ben Taub General Hospital, Houston, Texas

	King Edward Memorial Hospital (*n*=754)	Ben Taub General Hospital (*n*=174)	Odds ratio (95% CI)
Medical interventions			
Mechanical ventilation	140 (18.6%)	100 (57.5%)	0.17 (0.12–0.24)[a]
Red cell transfusion	291 (38.6%)	90 (51.7%)	0.67 (0.48–0.95)[a]
Fresh frozen plasma	205 (27.2%)	61 (35.1%)	0.69 (0.48–0.99)[a]
Cryoprecipitate	32 (4.2%)	30 (17.2%)	0.21 (0.12–0.37)[a]
Platelets	89 (11.8%)	41 (23.6%)	0.44 (0.29–0.68)[a]
Inotropic drugs	160 (21.2%)	40 (23.0%)	0.9 (0.6–1.36)
Dialysis	62 (8.2%)	6 (3.5%)	2.51 (1.02–6.55)[a]
Obstetric interventions			
Cesarean section	116 (15.4%)	136 (78.2%)	0.05 (0.03–0.08)[a]
Hysterotomy	4 (0.5%)	8 (4.6%)	0.11 (0.02–0.42)[a]
Hysterectomy	32 (4.2%)	26 (14.9%)	0.25 (0.14–0.45)[a]
Curettage	43 (5.7%)	21 (12.1%)	0.44 (0.25–0.79)[a]
Induction of labor	201 (26.7%)	66 (37.9%)	0.1 (0.06–0.16)[a]

[a] Difference was statistically significant ($p<0.05$)

Medical disorders were responsible for ICU admission in 274 (29.5%) patients (Table 5). Malaria, viral hepatitis, cerebral venous thrombosis (confirmed angiographically), CNS infections, leptospirosis, tetanus, and typhoid were seen exclusively in Indian patients. On the other hand, drug abuse, trauma, and anaphylaxis were seen only in American patients. Of the other disorders which occurred in both groups of patients, complicated urinary tract infection, acute abdomen, peripartum cardiomyopathy, primary bacteremia, malignant neoplasms, and bronchial asthma were more frequent in American patients, whereas cardiac arrest prior to ICU admission was more common in Indian ICU patients (Table 5).

Outcomes

Maternal mortality was 25% (189 deaths) in the Indian ICU and 2.3% (4 deaths) in the American ICU. All 4 deaths in the American ICU and 123 of the 189 deaths in the Indian ICU occurred in patients with obstetric diseases.

Fetal mortality too was higher in the Indian patients (51 vs 13%). Of the 386 fetal deaths in the Indian ICU patients, in 94 cases the fetuses were dead prior to hospital admission and the other 292 died after admission. Of the 23 fetal deaths in American patients, 8 occurred prior to hospital admission. The median length of ICU stay was higher by 1 day in Indian ICU patients (4 days, interquartile range 3–5 days) than in American ICU patients (3 days, interquartile range 2–4 days).

Prenatal care was an important predictor of outcome in both groups of patients. In the Indian ICU, there were 149 deaths (27%) in 402 patients who had not received prenatal care and 40 deaths (19.8%) in 202 patients who had received prenatal care (p=0.0006). In the American ICU, only 1 (0.7%) of 150 patients who had received prenatal care died, vs 3 deaths (12.5%) in 24 patients who did not receive prenatal care (p=0.0085). Patients who did not receive prenatal care also had higher APACHE II scores (median 18.3) as compared with patients receiving regular prenatal care (median APACHE II score 13.1; $p<0.001$).

Discussion

We analyzed the obstetric admissions to medical intensive care units located in two countries, which were contrasting in terms of economic development, organization of the health care system, per capita health care expenditure, and birth rates. In both ICUs, about 70% of ICU admissions were for obstetric disorders. Pre-eclampsia/eclampsia, antepartum hemorrhage due to placental abruption and placenta previa, acute fatty liver of pregnancy, amniotic fluid embolism, postpartum hemorrhage, and uterine rupture were equally common in both groups; however, HELLP syndrome occurred more often in American patients (17.8 vs 5.6% in KEMH patients). A similar racial difference has been observed in a previous study from Canada where Caucasian women had a 2.24 times higher incidence of the HELLP syndrome than women of Asian Indian origin [17]. The reasons for this difference are not clear. Abnormalities of placental adherence leading to postpartum hemorrhage too were common in BTGH patients, probably because more of these women had had Caesarean section in previous pregnancies [4].

Unlike obstetric disorders, medical disorders differed vastly in the two groups. Severe sepsis due to complicated urinary infection occurred in 10.3% of American patients. Urinary tract infections are more common and also more severe in pregnancy because of vesicoureteric reflux due to pressure on the urinary bladder by the gravid uterus and dilatation of the ureters secondary to the effect of progesterone [18]; however, complicated urinary tract infection was rare in Indian patients (0.3%). Sexual inter-

course has been shown to increase risk of urinary infection five to tenfold and is implicated as the most important factor in the pathogenesis of urinary infection in young women [19]. Indian women traditionally stay with their mothers during the latter half of pregnancy, away from their husbands. The resulting abstinence from sexual intercourse could explain the lower incidence of urosepsis in the Indian patients. This can also explain why 12.6% of BTGH patients had sepsis due to chorioamnionitis compared with 0.9% of KEMH patients. Sexual intercourse is also an important cause of bacterial vaginosis and premature rupture of membranes, both of which are risk factors for chorioamnionitis [20].

Severe malaria accounted for nearly 10% of all admissions in the Indian ICU. In women residing in areas where falciparum malaria is endemic, the normal change of the immune response to a predominant TH_2 type during pregnancy results in loss of acquired immunity against Plasmodium falciparum [21]; hence, malaria tends to be more severe in pregnant women and mortality may be as high as 25% [22]. Acute viral hepatitis, especially due to water-borne hepatitis A and E viruses, is common in India [23, 24]. Hepatitis A is responsible for 1.5% of viral hepatitis in pregnant patients, whereas hepatitis E infection accounts for 60–75% of cases [23, 24, 25]. Pregnant women are more susceptible to hepatitis E virus infection and are also more likely to develop fulminant hepatic failure as compared with non-pregnant women [23, 24]. Viral hepatitis was seen in 47 (6.2%) KEMH patients. Most of these women had fulminant hepatic failure.

Suicidal poisoning or drug overdose were seen in 13 Indian ICU patients and only 1 American ICU patient. Although the difference fell short of statistical significance, the greater incidence of suicidal attempts in Indian women reflects the high incidence of depression during pregnancy and postpartum period [26] in this population. Stress and depression are common because of poverty, burden of household chores (usually fall on the youngest daughter-in-law) in an extended family, demands for dowry, societal gender bias, violence against women, tendency to blame women for birth of female children, and lack of control over decisions pertaining to their own health including the pregnancy [26, 27]. On the other hand, recreational drug abuse is extremely rare in Indian women but is frequent in American women [28]. Substance-abuse-related problems accounted for five admissions to the BTGH ICU and none in the Indian ICU.

Another condition seen exclusively in Indian patients was cerebral venous sinus thrombosis, which occurred in 26 women; 80% of these occurred in the postpartum period, within the first 2 weeks after delivery. Hormonal changes in pregnancy produce a hypercoagulable state with a 120–300% increase in levels of clotting factors and decrease in circulating antithrombotic proteins [29]. This, along with dehydration during labor and puerperium, predisposes to cerebral venous thrombosis [30]. Only 20% of these women had received postnatal medical care; thus, while the incidence of other disorders may be related to lack of antenatal care, cerebral venous sinus thrombosis emphasizes the hazards of poor postnatal care.

There were significant differences in patterns of organ dysfunction in the two ICUs. This was due to differences in the obstetric and medical conditions that resulted in ICU admission. Central nervous system dysfunction was common in Indian ICU patients in whom eclampsia, cerebral malaria, CNS infections, hepatic coma, and cerebral venous thrombosis were major causes. Renal failure too was more frequent in Indian patients due to a combination of pre-eclampsia, disseminated intravascular coagulation, postpartum hemorrhage, and shock. Severe malaria, leptospirosis, and acute fatty liver of pregnancy too were important causes of renal failure. Hematological dysfunction was the commonest organ affected in the American ICU patients followed by respiratory failure. Bacterial sepsis and disseminated intravascular coagulation due to obstetric disorders were responsible for most cases of hematological failure, and community-acquired pneumonia, acute asthma, and acute respiratory distress syndrome (ARDS) due to abdominal sepsis were the common causes of respiratory failure. Cardiovascular failure, mainly due to obstetric hemorrhage, or cardiogenic shock in rheumatic heart disease was more common in Indian patients. Hepatic dysfunction was equally common in the two groups, but the causes differed: acute viral hepatitis in Indian patients was balanced by the higher incidence of HELLP syndrome in American patients. Differences in the use of ICU resources in the two ICUs closely matched the pattern of organ affection. More American patients received mechanical ventilation and transfusion of blood products, whereas more Indian patients received hemodialysis.

There was a marked difference in maternal mortality between the Indian and American ICU. Mortality in the Indian ICU was 25%, whereas it was only 2.7% in the American ICU. Several reasons could explain this difference. Only 27% of Indian women (vs 86% of American women) had attended prenatal clinics; mortality in patients who received regular prenatal care was significantly lower than patients who had not. While non-availability of health care services may be an important issue in rural India, this is definitely not the case in Mumbai. Free prenatal services are available at state-funded centers, but long queues and wait times limit their use. Private health care is expensive and cost of regular prenatal visits is prohibitive [4, 31]. Some patients do not seek medical attention during pregnancy because of social misconceptions and up to 40% of deliveries in rural India take place at home, unsupervised by medical personnel [31]. The high number of Indian women with pre-eclampsia manifesting with seizures is a clear reflection of their non-utilization of prenatal care services, as is the interval between onset of acute illness and hospital admission. This also explains

higher APACHE II scores, greater incidence of cardiac arrest prior to hospital admission, and high rate of intra-uterine fetal death in Indian women.

The other reason for the difference in maternal and fetal outcome is evident from the obstetric interventions in the two groups. In many obstetric disorders including severe pre-eclampsia, prolonged intra-uterine fetal death and acute fatty liver of pregnancy, early delivery can be lifesaving by preventing complications such as seizures, DIC, hepatic encephalopathy, and renal failure [32, 33]. Removing the fetus from the compromised uterine environment also improves fetal outcome [32, 33]. Neonatology services are restricted to only a handful of centers in India, even in large cities. Given the likelihood of poor fetal survival if delivered prematurely, pregnant women and their families decline early elective delivery at a stage when the illness can be managed in primary or secondary care centers. It is therefore not surprising that induction of labor was performed in only 26.7% of Indian women (vs 38% in BTGH patients) and cesarean section in 16% (vs 78% in BTGH patients). This aggressive obstetric approach and better neonatology facilities may have accounted for the low maternal and fetal mortality in the BTGH patients; however, surgical intervention in patients with shock, severe organ dysfunction, and coagulopathy increase the risk of complications, especially hemorrhage and postoperative abdominal and pelvic sepsis [34]. This explains the greater need for transfusion of packed red cells and blood products and higher incidence of puerperal sepsis in BTGH patients. Nevertheless, the far superior maternal and fetal outcomes prove that this approach is fully justified, despite the complications.

Conclusion

Besides demonstrating differences in availability of prenatal care and utilization of health care facilities, this large series of critically ill obstetric patients from two different regions of the world also highlights the differences in case mix, organ dysfunction, and provides a descriptive analysis of critical illness in these two populations and intensive care needs. This study also shows how medical and obstetric disorders and their outcomes are affected by social customs, traditions, economics, and patterns of endemic infections. Besides possible differences in quality of ICU care, the main factor contributing to better maternal and fetal outcome in the BTGH cohort is probably the aggressive and timely obstetric intervention. Attention to many of these issues is needed to reduce maternal and fetal mortality and morbidity in developing countries such as India.

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