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7. DISCUSSION

Abdominal and pelvic trauma is one of the important causes of mortality in accidents. It's incidence is fast increasing due to various factors relating to modern civilization. The fast increasing incidence can be explained by lack of proper planning and failure to develop infrastructure to cope with the hazards of modern civilization.

A prospective study was, therefore, undertaken at the Department of Forensic Medicine, Maulana Azad Medical College and Associated Hospitals, New Delhi to study types of abdominal and pelvic injuries and various factors related to them.

INCIDENCE AND PROBLEMS

The prospective study was done for a period of eleven and a half months from 1st March 1996 to 15th February 1997. The total number of cases studied were 122. It represents only a part of the problem of fatal abdominal and pelvic trauma in Delhi since the total number of such cases are distributed in different mortuaries which are catering to different regions/areas of the Delhi. Many of the factors attributable to increase in abdominal and pelvic trauma are: (1) Increased traffic accidents; (2) Increase in high rise/level buildings; (3) Increased industrialization; and (4) Increased crime rate due to terrorist activities, antisocial elements, militant attacks, etc.

Majority of the victims of abdominal and pelvic trauma were due to traffic accidents. Factors contributing to increased number of fatal accidents in Central Delhi includes multiplicity of the vehicles running on the same road, overcrowding, and to a large extent lack of traffic sense, mainly amongst Redline bus and truck drivers. Pedestrians crossing the roads at their own will; especially at busy traffic points like I.T.O red light crossing, Desh Bandhu Gupta Road-Faiz Road red light crossing, etc., have also contributed to increased fatalities.

In abdominal and pelvic injuries, it is very crucial to accurately appraise the full extent of injury involving various organs/structures. The management and outcome of the case depends on the identification of the organ involved in the trauma cases.

EPIDEMIOLOGICAL FACTORS

AGE OF THE VICTIMS

In the present study of abdominal and pelvic trauma victims, it was observed that majority of the cases were in the age group of 21-30 years (38.52%). Similar findings have also been reported by Kaare Solhem (1963), Rush E. Netterville (1967), R. Chandulal (1971), B. Risberg (1976), J. Chandra et

al (1979), D. Bergvist et al (1980), D. Bergvist et al (1983), A.K. Sharma (1986), B.W. Sathiyasekaran (1991), and E.O. Odelowo (1994). Martin A. Croce et al (1992) and L.P.H. Leenan et al (1993) showed involvement of mean age of 30 and 28 years respectively. G.C. Velmahos et al (1995) and R.D. Levy et al (1995) reported involvement of mean age of 28 years. Barry M. Renz and David V. Feliciano (1995) and Elias Degiannis et al (1996) found involvement of mean age of 29.8 and 30 years respectively in their study. A large number of cases in this age group can be explained by the fact that young persons in this age group are at the peak of their creativity and have the tendency to take undue risk, thereby subjecting themselves to the hazards of accidents and injuries. Low incidence in children under 10 years of age could be due to better treatment facilities, better education and more attention paid by the parents. It was found that majority of the cases (73.77%) belonged to the working age group (21-60 years).

SEX OF THE VICTIMS

In the present series, it was observed that males dominated females in the ratio of 9.16:1. This dominance of males has also been reported by various workers - R.D. Williams and R.M. Zollinger (1959), Kaare Solhem (1963), Rush E. Netterville (1967), B. Risberg (1976), J. Chandra et al (1978), D. Bergvist et al (1980), A.O. Adeyemo et al (1984), B.J. Brainard et al (1989), Soren B. Albrektsen et al (1989), E.M. Guirguis et al (1990), B.W. Sathiyasekaran (1991), J.D. Feczko et al (1992), Martin A. Croce et al (1992), Mary L. Brandt et al (1992), A. Bradbury et al (1993), Bernard R. Boulanger et al (1993), H. Leon Pachter et al (1993), L.P.H. Leenan et al (1993), Ming Liu et al (1993), A.J. Mazurek (1994), G. Solovei et al (1994), G. V. Poole et al (1994), Ari Lepaniemi et al (1995), Barry M. Renz et al (1995), G.C. Velmahos et al (1995), G. Regel et al (1995), P. Catoire et al (1995), R.D. Levy et al (1995) and Elias Degiannis et al (1996). This dominance of males in readily explainable by the fact that males are more exposed to hazards of roads, industry, violence and sports as they constitute working and earning member in majority of the families.

SOCIO-ECONOMIC STATUS

In the present series, maximum number of victims of abdominal and pelvic trauma were from the lower economic class (52.45% in total 122 cases and 57% in 100 vehicular accident cases). This tallies with the findings of the study conducted by CRRI (central Road Research Institute). In Delhi, study says that almost all the pedestrians killed belonged to low economic strata, and as much as 50% of them were totally uneducated and another 20% had received only primary level education *(Times of India-February 12, 1996)*.

AGENTS

In the present series, majority of abdominal and pelvic injuries were non-penetrating (94.26%), out of which maximum number (86.96%) were due to vehicular accidents. Similar findings were also observed by Allen and Curry (1957), Meyer (1970), J. Chandra et al (1979), D. Bergvist et al (1980), V. Ibanez Martinez et al (1981), D. Bergvist et al (1983), A.K. Sharma (1986), A.C Cass et al (1987), M. Schmitz et al (1989), E.M. Guirguis et al (1990), P.M. King et al (1994) and Mary O. Aaland et al (1996). Road traffic accidents as the most common cause of blunt trauma injuries has also been reported by E.M. Orsay et al (1990), B.W. Sathiyasekaran (1991), K.E. Daly et al (1992), Martin A. Croce et al (1992), Bernard R. Boulanger et al (1993), A.J. Mazurek (1994), C.L. Ong et al (1994), G. Scannell et al (1995), G.C. Velmahos et al (1995), G. Regel et al (1995), M. Ndiaye et al (1995) and P. Catoire et al (1995). Majority of vehicular accidents were due to Redline buses (38%) followed by trucks (16%) which can be explained by the fact that most of the drivers were rash in driving poorly maintained

vehicles. In the present series, penetrating abdominal injuries were found in 5.74% of total cases, out of which 71.43% were due to stab injury and 28.57% due to firearm injury. Similar low incidence of penetrating trauma injuries has also been reported by Gavin W. Bowyer (1995) and G. Regel et al (1995). This dominance of knives over firearms as a cause of penetrating injuries has also been reported by Meyer (1970), D. Bergvist et al (1980) (in urban population only), A.K. Sharma (1986), Barry M. Renz et al (1995), G. Regel et al (1995) and Joseph M. Klausner et al (1995). The reason cited is that the knives are easily available, cheap and easy to conceal before attack on assailant. It may be recalled here that most of these cases are homicidal in nature. Statistics available with the Delhi Police also clearly indicates that majority of the murders in the city are committed with the help of knives or similar sharp weapons *(Indian Express-January 30, 1997)*.

TYPE OF VICTIMS IN VEHICULAR ACCIDENT CASES

In the present series, majority of the victims of vehicular accidents sustaining abdominal and pelvic trauma were among pedestrians (53%). Similar increased incidence of abdominal and pelvic trauma among pedestrians have also been reported by J.P. McCarroll (1962), Kaare Solhem (1963), R. Chandulal (1971), J. Chandra et al (1978, 1979), D. Bergvist et al (1983), P.K. Ghosh (1984) and A.K. Sharma (1986). Martin A. Croce et al (1992) and Bernard R. Boulanger et al (1993) reported pedestrian-vehicle collisions in 7% and 11% cases respectively. The study conducted by CRRI (Central Road Research Institute) says that in the urban areas, three-fourths of the road fatalities were those of pedestrians and in Delhi, pedestrians account for 43 percent of fatalities *(Times of India-February 12, 1996)*. This increased fatalities among pedestrians can be explained by the factors like lack of traffic sense, poor lighting of streets, infirmity, crossing roads away from the marked safety zone, inoperability of traffic light signals, drinking etc.

ENVIRONMENTAL FACTORS

DIURNAL VARIATION IN VEHICULAR ACCIDENT CASES

In the present series, maximum number of vehicular accidents occurred at night time reaching a peak between 9.01 P.M.-12 A.M. (Midnight) accounting for 18% of the cases. This tallied well with the findings of Bruce H. Smith et al (1969) who recorded a peak between 5 P.M.-12 A.M. (Midnight). The reasons for this high incidence includes-inefficient lighting on the roads, overcrowding, disobeying of traffic rules, inoperability of traffic light signals, drinking, etc. Delhi boast of 20 percent of conked out traffic lights at any given time, more so during late evening and night hours either due to failed power supply or technical faults. It was estimated that at least 200 persons, mostly two-wheeler riders, died in the past one year due to dead traffic lights at road crossings (*Indian Express-March 8, 1997*).

The second peak occurred during the period of 6.01 P.M.- 9 P.M. accounting for 15% of total cases. J.I. Tonge et al (1972) recorded a peak between 6 P.M. - 9 P.M. This time period interval represents peak hours of traffic rush as most of the people are returning back to their houses from the offices, business premises, colleges and shopping centers.

The statistics available with the Delhi Traffic Police regarding city's fatal hours for the period-January 1 to April 30, 1996 showed that 77 persons were killed in road accidents between 8 P.M. and 12 A.M. (*Times of India, Delhi Times-July 5, 1996*).

SURVIVAL PERIOD

In the present study, spot dead and brought dead cases accounted for 19.67% cases each. This emphasizes the fact that these victims need on the spot emergency medical care and rapid transportation from the incident site to the hospital. S. Sevitt (1968) reported spot deaths in 16% cases. K.E. Daly and P.R. Thomas (1992) reported that majority of the deaths due to multiple injuries (70%) occurred before arrival at hospital. It was noticed that youngster of second and third decade, victims with low ISS score and victims with associated injuries of chest had long survival period as compared to children and elderly people, victims of high ISS and victims with associated injuries of head who had considerably short survival period. These variations in survival period with age, ISS and associated injuries can be of great value in the management of abdominal and pelvic trauma cases.

FREQUENCY OF MULTIPLE INTRA-ABDOMINAL INJURIES

In the present series, majority of the victims (63.11%) had multiple intra-abdominal injuries. Similar findings have also been reported by Kaare Solhem (1963), G.A. Barashkov et al (1978), V. Ibanez Martinez et al (1981), D. Bergvist et al (1983), A.K. Sharma (1986), A.J. Mazurek (1994) and D.S. Talton et al (1995). This high incidence can be explained by the following facts: (1) Penetrating wounds of lower chest often extend through the diaphragm and injure the liver, spleen, stomach or intestines; (2) Penetrating wounds of the abdomen mainly from firearms often causes widespread visceral damage because of missile's capricious course, ricocheting effect and burning effect as a result of thermal injury; (3) Blunt injuries of abdomen as result of compression, traction or bursting forces causes widespread involvement of internal abdominal viscera.

DETAILS OF ORGANS INVOLVED

DIAPHRAGM

In the present study, majority of cases of diaphragmatic injuries were due to vehicular accidents which tallied well with the findings of G.F. Asbury (1968), R. Chandulal (1971), A.K. Sharma (1986), O.P. Sharma (1989), M.L. Brandt et al (1992), Bernard R. Boulanger et al (1993), W.C. Lee et al (1994) and G. Regel et al (1995). Right hemi diaphragm was injured in the ratio of 1.5:1 over left hemi diaphragm. This increased incidence of right hemi diaphragm is due to increase in vehicular accidents where impact was from the right side mainly. Majority of penetrating diaphragmatic injuries (75%) in the present series were secondary to penetrating chest injuries which tallied well with the findings of Frederick W. Ackroyd (1977), Sonny S. Oparah et al (1978) and A.K. Sharma (1986).

OMENTUM

The omentum showed contusion injury in majority of the cases (90.48%). This is in conformity with the reported statement of Bailey and Love (1983) that omentum acts as an "Abdominal Policeman" and gives protection to intra-abdominal viscera underneath it.

LIVER

In the present series, liver injuries due to blunt trauma were observed in 94.32% of cases, of which majority of cases were due to vehicular accidents. Similar findings have also been reported by Meyer (1970), R. Chandulal (1971), Polson and Gee (1973), J. Chandra et al (1978) and (1979), D. Bergvist et al (1983), A.K. Sharma (1986), E. Arajarvi et al (1989), O.P. Sharma (1989), G. Regel et al

(1995) and Kimberly A. Davis et al (1996). Majority of the cases had involvement of right lobe of liver and its front (anterior) surface. This has been confirmed by similar findings described by Taylor (1965) and A.K. Sharma (1986). Majority of cases showed laceration injury including superficial and deep lacerations. Piecemeal pulpy liver was noticed in 11.36% of the cases. The above mentioned different types of liver injuries have also been described by E.T. Mays (1966), P.H. Kindling et al (1969), George F. Woelfel et al (1984), A.K. Sharma (1986), Ian V. Lau et al (1987), D.C. Viano et al (1993), Katsuhiko Sugimoto et al (1993) and Kimberly A. Davis et al (1996). In the present series, penetrating trauma directed towards right and left costal and subcostal regions by the firearm or knife (in majority of cases) was found to cause injury to liver. Similar corresponding injuries in relation to regions of abdomen have also been reported by Meyer (1970) and A.K. Sharma (1986). In one of the cases, bullet entered through the 5th intercostal space on left side of chest, passed obliquely downwards injuring the diaphragm, both lobes of liver and small intestinal loops and finally got lodged in the mesentery of small intestines. J.F. Dickson et al (1961), Sonny S. Oparah et al (1978) and M.L. Brandt et al (1992) reported similar combined involvement of diaphragm and liver following penetrating wound of the chest. 40% of the liver injuries were noticed following penetrating wounds of the abdomen, which tallied well with the reported incidence of 45% by B. Risberg (1976) and 44.4% by A.K. Sharma (1986). J.E. Pridgen et al (1967) and MarkFielder et al (1985) reported incidence of liver injuries as 22.8% and 22.2% respectively following penetrating abdominal wounds. Liver was reported to be the most commonly injured organ following penetrating abdominal trauma by Allen and Curry (1957), James (1981) and Paul S. Collins et al (1988). Liver was found injured in 72.13% of total l22 cases of abdominal and pelvic trauma which tallied well with the reported findings of A.K. Sharma (1986), D.C. Viano et al (1989), Martin A. Croce et al (1992) and C.L. Ong et al (1994).

SPLEEN

In the present series, all cases of spleen injuries were due to blunt force impact of which majority (86.79%) occurred due to vehicular accidents. Similar findings have also been reported by D. Elonomy et al (1960), O.S. Lung et al (1961), R.A. Griswold and H.S. Collier (1961), R. Chandulal (1971), Frederick W. Ackroyd (1977), D. Charles et al (1982), D. Bergvist et al (1983), A.K. Sharma (1986), E. Arajarvi et al (1989), O.P. Sharma (1989), Ming Liu et al (1993), C.L. Ong et al (1994), W.L. Abrantes et al (1994) and G. Reigel et al (1995). Pedestrians (50.94%) and vehicle occupants (35.85%) were found to have spleen injuries following vehicular accidents in the present study. D. Elonomy et al (1960) reported incidence of pedestrians as 38.3% and vehicle occupants as 40%. In the present study, majority (64.15%) of spleen injuries were found associated with rib fractures following road traffic accidents, which tallied with the opinion of Gordon and Shapiro (1982) and A.K. Sharma (1986). Frequency of spleen injuries due to blunt trauma other than vehicular accidents observed were as follows:

(1) Fall from height - 5.66%; (2) Assault by blunt weapons - 3.77%; (3) Collapse of roof/fall of heavy object - 1.89%; and (4) Beaten by hands and legs - 1.89%. Similar low incidence in the aforesaid causes of spleen injuries was also observed by D. Elonomy et al (1960), O.S. Lung et al (1961) and A.K. Sharma (1986).

PANCREAS

In the present series, pancreas was involved in 9.84% of total cases of abdominal and pelvic trauma. Low incidence of pancreatic injury can be explained by its deep and well protected

anatomical position. Similar findings has also been reported by R.A. Griswold and H.S. Collier (1961), I. Leonard (1962), J.E. Pridgen and A.F. Heriff (1967), Polson and Gee (1973), D. Bergvist (1983), MarkFielder et al (1985), A.K. Sharma (1986), Soren B. Albrektsen (1989) and Ming Liu et al (1993). 83.33% cases of pancreas injuries in the present study were due to vehicular accidents, which tallied well with the findings of Meyer (1970), A.K. Sharma (1986), Ming Liu et al (1993), R. Rigon et al (1994) and M.H. Craig et al (1995). In the present series, 33.33% of pancreas injuries were found associated with injuries of stomach which can be explained by the fact that maximum number of stabs passed through the stomach before injuring pancreas. Penetrating trauma directed towards epigastrium or left subcostal region (back side) was found to cause injury to pancreas. Similar corresponding injuries in relation to regions of abdomen have also been confirmed by Meyer (1970) and A.K. Sharma (1986).

ADRENALS

Adrenal injuries with resultant haemorrhage was noticed in five cases and all of these cases were caused by vehicular accidents. Similar findings of adrenal haemorrhage following closed abdominal injury due to automobile accidents has also been reported by S. Sevitt (1968), A.K. Sharma (1986) and J.V. Lewis (1994).

Such an injury usually add its effect towards the shock sustained by decreased after sustenance of other injuries inside abdomen.

STOMACH

In the present series, majority (62.50%) of stomach injuries were due to blunt trauma of abdomen and all of these cases were due to vehicular accidents. Out of total 122 cases, stomach injuries were observed in 6.56% of the cases. This low incidence can be explained by the well protected position of stomach behind the left lobe of liver and lower left rib cage. This tallied with the findings of Meyer (1970), Polson and Gee (1973), Gordon and Shapiro (1982), Ming Liu et al (1993) and Gavin W. Bowyer (1995). Penetrating trauma directed towards the epigastrium in the midline by the knife and/or bullet entering the body of the victim through back side of left abdomen and traveling forwards to pierce the stomach was found to cause stomach injuries. Similar corresponding injuries in relation to regions of abdomen have also been confirmed by J.E. Pridgen and A.F. Heriff (1967), Meyer (1970), Polson and Gee (1973), James (1981), MarkFielder et al (1985), A.K. Sharma (1986) and Gavin W. Bowyer (1995).

SMALL INTESTINES

In the present study, small bowel was involved in 11.48% of total cases of abdominal and pelvic trauma. Majority of the blunt trauma injuries (92.31%) were due to vehicular accidents. S.A. Resnicoff and J.H. Morton (1969), Herbert B. Hechtman (1977), A.K. Sharma (1986) and D.S. Talton et al (1995) also reported vehicular accidents as the main cause of small bowel injury. Types of small bowel injuries encountered were lacerations, which tallied with the findings of J.P. Evans (1973), Barry M. Renz et al (1995) and D.S. Talton et al (1995). In the penetrating small bowel injury case, bullet entered through left costal area and pierced through the left hemi diaphragm and liver before entering into the small bowel loops. Similar corresponding penetrating injuries of the small bowel have also been reported by J.E. Pridgen and A.F. Heriff (1967), Meyer (1970), G. Kelley et al (1978), Rao R. Ivatuary et al (1982), MarkFielder et al (1985), Gavin W. Bowyer (1995) and R.D. Levy et al (1995).

LARGE INTESTINES

In the present series, it was observed that majority of large bowel injuries were due to vehicular accidents. Similar findings have also been reported by Polson and Gee (1973), Richard G. Strate and John G. Grieco (1983), A.K. Sharma (1986) and Ming Liu et al (1993). Majority of the study cases (72.73%) showed involvement of all parts of the colon, especially ascending colon and transverse colon, which can be explained by the fact that majority of large bowel injuries occur at the junction of the mobile and immobile parts of the bowel. These findings are similar to the reported findings of Polson and Gee (1973), Herbert B. Hechtman (1977) and Richard G. Strate and John G. Grieco (1983). Blunt or penetrating force impact causing large bowel injury was directed towards iliac fossa and lumbar region, which was in confirmation with J.E. Pridgen and A.F. Heriff (1967), Meyer (1970), Herbert B. Hechtman (1977), James (1981), MarkFielder et al (1985), Gavin W. Bowyer (1995) and R.D. Levy et al (1995). In one case of penetrating trauma to the large bowel, bullet after entering the body of victim through back side of right abdomen pierced through the ascending colon and exit out from front of right abdomen.

GALL BLADDER

Injury to gall bladder was observed in only two cases (1.64%) out of total 122 cases studied. This low incidence can be explained by the fact that gall bladder lies well protected by the liver and costal margin. In one of the case studied, gall bladder was completely transected along with associated multiple lacerations of the liver due to crushing effect following run over by a Red line bus. This tallied with the reported findings of J.E. Pridgen and A.F. Heriff (1967), A.K. Sharma (1986) and L.F. Zantut et al (1992).

PERITONEAL AND RETRO-PERITONEAL HAEMORRHAGES

Majority of cases of peritoneal haemorrhage in the present study were due to combined liver and spleen injuries (36.19%) followed by liver injuries alone (35.24%). This tallied well with findings of Gordon and Shapiro (1982), A.O. Adeyemo et al (1984), A.K. Sharma (1986), Ian. V. Lau et al (1987), Barry M. Renz et al (1995) and M. Ndiaye et al (1995).

Retro-peritoneal haemorrhage was caused by blunt trauma in majority of cases (83.33%) produced by vehicular accidents and was found associated with pelvic fractures in majority of the cases (50%). Similar findings have also been reported by P.W. Braunstein (1964), Meyer (1970), M.J. Orloff and A.C. Charters (1972), Herbert B. Hechtman (1977), John G. Grieco (1980), Soren B. Albrektsen et al (1989) and Ming Liu et al (1993).

MESENTERY

In the present series, majority of cases of mesenteric injuries (82.50%) were due to vehicular accident, which tallied with the reported findings of A.K. Sharma (1986), Ming Liu et al (1993) and B.W. Nolan et al (1995). 35.90% of mesenteric injuries were associated with ruptures of the bowel. Blunt force impact directed towards suprapubic region and lower back of abdomen was found to cause mesenteric injury in confirmation with findings of Meyer (1970), A.K. Sharma (1986), Ming Liu et al (1993) and B.W. Nolan et al (1995). In penetrating injuries of mesentery, trauma directed toward right hypochondrium and secondary to penetrating injuries of left costal region was found to involve mesentery of small bowel and transverse mesocolon respectively, which tallied with findings of Meyer (1970) and A.K. Sharma (1986).

VASCULAR INJURIES

In the present series, most common type of vascular injury noted (66.67%) was the combined abdominal aorta and inferior vena cava ruptures (along with their respective branches) following vehicular accidents. A.K. Sharma (1986), Wanda W. Young et al (1991) and J.R. Garrison et al (1995) also reported involvement of vascular structures following vehicular accidents. In penetrating trauma injuries of vascular structures, trauma directed towards epigastrium by the sharp edged knife was found to cause injury to the abdominal aorta at two levels or sites. Similar corresponding injury in relation to epigastrium has also been reported by Meyer (1970) and Sharma (1986). Penetrating injuries of vascular structures have been reported by J.E. Pridgen and A.F. Heriff (1967), A.K. Mandal and M.A. Boiiano (1978), Milton Brinton et al (1982), Rao R. Ivatuary et al (1982), MarkFielder et al (1985), Paul S. Collins et al (1988), Michael F. Rotondo et al (1993), Gavin W. Bowyer (1995), R.D. Levy et al (1995) and Elias Degiannis et al (1996).

GENITO - URINARY INJURIES

Genito-urinary injuries were observed in 47.54% of total cases of abdominal and pelvic trauma. R.D. Levy et al (1995) reported 38.46%% cases of genito-urinary system injuries in their study.

KIDNEYS

In the present study, kidneys were involved in 29.51% of total cases of abdominal and pelvic trauma. Similar high incidence of the kidney injuries has also been observed by V. Ibanez Martinez et al (1981), D. Bergvist et al (1983), A.C. Cass et al (1987) and G. Regel et al (1995). In the present series, majority (72.22%) of the kidney injuries were found following vehicular accidents which tallied well with the findings of E.F. Nation and B.D. Massy (1963), Meyer (1970), B. Osias Marc (1976), V.Ibanez Martinez et al (1981), A.S. Cass (1983), A.K. Sharma (1986), A.C. Cass et al (1987), J. Medica and A. Caldamone (1995) and G. Regel et al (1995).

URINARY BLADDER

In the present series, all cases of bladder injuries were due to vehicular accidents, which is in confirmation with the findings of J.J. Flaherty et al (1968), R. Chandulal (1971), Gordon and Shapiro (1982), A.K. Sharma (1986), A.C. Cass et al (1987), Soren B. Albrektsen (1989) and Paul D. Jo et al (1996). In the present study, all cases of bladder injuries were associated with pelvic fractures. Similar findings have been observed by J.J. Flaherty et al (1968), R.D. Levy et al (1995) and Paul D. Jo et al (1996).

URETHRAL INJURIES

All cases of urethral injuries were observed to be caused by blunt trauma produced by vehicular accidents. All cases showed associated pelvic bone fractures. Similar findings have been observed by H.D. Morris and A.W. Dunn (1968), A.K. Sharma (1986), A.C. Cass et al (1987), Guido Barbagli et al (1987) and Mark B. Noss et al (1996).

UTERUS AND OVARIES

In the present series, uterus and ovaries were injured in one case each out of total 122 cases and causative agent was vehicular accidents (blunt trauma) in both cases . R. Chandulal (1971), David Charles and Joel Rankin (1977) and A.K. Sharma (1986) have also reported injuries to uterus and ovaries in cases of direct violence following vehicular accidents. Low incidence of uterus injury has also been observed by Elias Degiannis et al (1996) in abdomino-pelvic trauma cases.

SKELETAL INJURIES

PELVIC BONE INJURIES

In the present study, pelvic bone fractures were observed in 47.54% of total cases, of which majority of the cases (94.83%) were as a result of vehicular accidents. Similar high incidence of pelvic fractures has also been reported by D. Bergvist et al (1983), A.K. Sharma (1986), B.J. Brainard et al (1989), Soren B. Albrektsen et al (1989), Wanda W. Young et al (1991), Bernard R. Boulanger et al (1993), M.R. Felenda et al (1993) and R.D. Levy et al (1995). Vehicular accidents as the main causative factor of pelvic fractures have also been observed by L.F. Peltiers (1965), H.D. Morris et al (1968), R. Chandulal (1971), J. Chandra et al (1978), D. Bergvist et al (1983), P.K. Ghosh (1984), A.K. Sharma (1986), B.J. Brainard et al (1989), O.P. Sharma (1989), Soren B. Albrektsen et al (1989), Wanda W. Young et al (1991), Bernard R. Boulanger et al (1993), K.P. Edwards (1993), L.P.H. Leenan et al (1993), M.R. Felenda et al (1993), Robert C. McIntyre, Jr et al (1993), G.V. Poole et al (1994), G. Scannell et al (1995), G. Regel et al (1995), Jan O. Jansen et al (1996) and Mark B. Noss et al (1996).

In the present series, commonest combination of pelvic bone fractures (18.96%) observed was multiple fractures of both sides pelvis plus fracture separation of pubic symphysis plus fracture dislocation of sacro-iliac joint. Different combinations of pelvic bone fractures have also been reported by H.D. Morris and A.W. Dunn (1968), Wanda W. Young et al (1991), K.P. Edwards (1993), M.R. Felenda and K.K. Dittel (1993), Robert C. McIntyre, Jr, et al (1993), E. Mayr et al (1994), N. Schwarz et al (1994), G. Scannell et al (1995), G. Regel et al (1995), P. Luthje et al (1995), Jan O. Jansen et al (1996) and Mark B. Noss et al (1996).

It was observed that three cases (5.17%) died following pelvic fractures as a result of retro-peritoneal haemorrhage. Meyer (1970) has also reported pelvic fractures as the main cause of retro-peritoneal haemorrhage. The cause of death in these cases of pelvic fractures was probably the combined effect of fracture and retro-peritoneal haemorrhage leading to shock in all the three cases.

VERTEBRAL INJURIES

In the present series, the most common level of fracture dislocation of lumbar spinal column was L_1 vertebra in 28.57% cases. Injuries to lumbar vertebral spinal column have also been observed by the J.K. Mason (1978), Ronald E. Rosenthal and E.R. Lowery (1980), K. Rumball and J. Jarvis (1992), F. Baumer et al (1993) and G.C. Velmahos et al (1995). In one out of the two cases of L_1 fracture dislocation, the causative factor was collapse of roof over the victim which is in conformity with the findings of J.K. Mason (1978). The explanation for the involvement of L_1 vertebral level in majority of the cases is as follows: (i) Whenever any heavy object or article falls, victim is mostly in crouched position; (2) Impact due to fall of heavy object or article either upon the head or shoulder cause further flexion of the dorso-lumbar vertebral junction and (3) As the dorsal spine is protected by thoracic cage, most of the strain falls at the junction of fixed and mobile parts of the spinal column causing fracture or fracture dislocation at the junction of thoraco-lumbar spinal column. Two of the cases in the present study had longitudinal fracture of the sacrum following vehicular accidents, similar to the reported findings of Sam W. Wiesel and Roger L. Terry (1979).

CAUSES OF DEATH FOLLOWING ABDOMINAL AND PELVIC TRAUMA

Main causes of death following abdominal and pelvic trauma are as follows:

(1) Haemorrhagic Shock

Intra-abdominal haemorrhagic shock was considered as the primary cause of death in 63 cases (51.64%) of which 57 cases (46.72%) were due to peritoneal haemorrhage and 6 cases (4.92%) were due to retro-peritoneal haemorrhage. Similar findings have been reported by Meyer (1970), G.A. Barashkov and L.N. Gubar (1978), Gordon and Shapiro (1982), D. Bergvist et al (1983), O.P. Sharma (1989), M. Schmitz et al (1989), M.W. Gordon et al (1989), E.O. Odelowo et al (1994) and P. Sahdev et al (1994). Majority of deaths (66.67%) in the present study due to peritoneal haemorrhage were as a result of injury to liver and spleen in consistent with findings of O.P. Sharma (1989) while majority of deaths (50%) in cases of retro-peritoneal haemorrhage were mainly due to pelvic fractures. M. Ndiaye et al (1995) reported that haemorrhagic shock accounted for 44.82% of deaths in trauma cases.

(2) Associated Head Injuries

In the present series, combined effect of head injury and haemorrhagic shock accounted for 50 cases (40.98%). This high incidence can be explained by increase in traffic accidents in Central Delhi. High incidence of head injury has also been reported by G.A. Barashkov and L.N. Gubar (1978), J. Chandra et al (1979), B.J. Brainard et al (1989) and D.S. Talton et al (1995). M. Ndiaye et al (1995) reported that brain damage accounted for 24.14% of deaths in trauma cases.

INJURY SEVERITY SCORE (ISS)

The relationship between ISS score and survival period in 100 vehicular accident cases out of total 122 cases in present study is shown in Table-V(b). This Table showed that victims with low ISS score had long survival period as compared to victims with high ISS score who had short survival period. The mean ISS score for the 100 vehicular accident cases was found to be 44 (range , 13-75). B.J. Brainard et al (1989) showed on ISS score of 46 in non-survivors. M. Bishop et al (1991) reported that 108 victims out of 400 cases were found to have an ISS score between 20 and 50. Bernard R. Boulanger et al (1993) and L.P.H. Leenan et al (1993) reported mean ISS score as 41+16.3 and 48(34-66,range) respectively. G. Scannell et al (1995) observed mean ISS score of 27+21.4 in their study. P. Catoire et al (1995) found mean ISS score of 37+10 after analyzing their cases. J.R. Garrison et al (1995) reported average ISS score of 38. Mark B. Noss et al (1996) found ISS score range as 19-50.