

## Traumatic Hemipelvectomy: Surgical and Medical-Legal Aspects

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Received date: Feb 10, 2014; Accepted date: Mar 03, 2014; Published date: Mar 08, 2014

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### Abstract

**Background:** Traffic accidents are major causes of disability and mortality due to the increasing number of vehicles, changes in lifestyle and high-risk behavior among the general population. Traumatic hemipelvectomy is a type of exceptional lesion representing 0.6% of all pelvic fractures, although lesions of the lower extremities are more usual than those of the upper extremities.

**Case presentation:** The authors present an unusual case of traumatic left hemipelvectomy, and consider the medical-legal aspects resulting from an accident of a motorcycle driver, which involved a lateral collision between the subject's motorcycle and a car.

**Conclusion:** With traumatic hemipelvectomy in young subjects difficulties arise at any level and in all medical fields: clinically, surgical and medicolegal

**Keywords:** Trauma; Hemipelvectomy; Traffic accidents; Lesion mechanism; Surgical aspects; Medical-legal aspects

### Background

Traffic accidents are major causes of disability and mortality due to the increasing number of vehicles, changes in lifestyles and high-risk behavior among the general population [1]. Globally, it is estimated that every year road accidents are attributable for 1.2 million deaths worldwide, and according to the World Health Organization this could increase by 80% in the coming years [2,3].

Road accidents are classified in ninth place among the leading causes of disability and years of life lost, and their position could increase to third place by 2020 [3].

In Italy in 2011 there were 205,638 road accidents involving personal injury. The number of deaths (within 30 days) was 3,860 and the injured numbered 292,019. Among the 2,690 dead drivers as a result of road accidents, the majority of affected individuals are in the 20-39 years age group (1,003 in total), particularly young people in the 20-24 year range and adults between 35-39 years [4].

Most of the victims were men aged 20 to 29, pedestrians or passengers/drivers of motorcycles [1].

In recent years, in fact, in big cities there has been a progressive increase of accidents involving drivers of motor vehicles, given that traffic problems have led to an increase in the use of these forms of transport as they are faster, more economical and more efficient [2].

In Italy, in general most categories of vehicles involved in road accidents are passenger cars (66.1%), motorcycles (14.0%), mopeds (5.4%) and bicycles (4.5%) [4].

The authors present an unusual case of traumatic left hemipelvectomy, resulting from an accident involving a motorcycle driver, and consider the related medical-legal aspects.

### Case Report

A male patient, 25 years, comes to the emergency room by ambulance in code red. Following a road accident involving a lateral collision between a motorcycle, of which the subject was the driver, and a car, the patient suffered the disarticulation of the left lower limb with left hemipelvectomy. On arrival at the emergency department, the patient was in a serious state of hypovolemic shock, with a heart rate of 136 beats per minute, respiratory rate 26/min, PA 68/52 mmHg, PaCO<sub>2</sub> 28 mmHg, PaO<sub>2</sub> 68 mmHg, HCO<sub>3</sub><sup>-</sup> 18 mmol/L, BE -4 mmol/L, O<sub>2</sub> Sat 95%.

We proceeded with the rapid infusion of a crystalloid intravenous and the transfusion of 10 units of blood, which led to a slight improvement in the patient's general condition. Objectively, the patient appeared pale, with clammy skin, piloerection and impairment of consciousness. At the level of the upper right could be seen: on the right flexor carpi ulnar is to 2 cm of olecranon a dark red ecchymosis 5 cm in diameter, and on the volar aspect of the right hand between the styloid process of the ulna and the pyramidal bone a red-coloured ecchymosis of smaller size (1.5 cm diameter). On both faces of the hand held hands multiple first-degree excoriation could be seen at the level of the distal phalanges and a roughly 3 cm second degree one on the right radial palmar surface at 1 cm below the proximal part of the first metacarpal. Besides complete amputation of the left lower limb (Figure 1), exposure of the residue of the iliac crest with defined and regular margins (Figure 2) was distinguishable in a hemorrhagic and clear laceration context, which as a result of impact had been torn apart and part of the skin tissue, fat and muscle had been completely removed with the loss of the left testicle. It proved easy to isolate the

distal part of the femoral nerve with its terminal roots (Figure 3): internal saphenous nerve, medial cutaneous nerve, nerve to the quadriceps muscle, lateral cutaneous nerve.

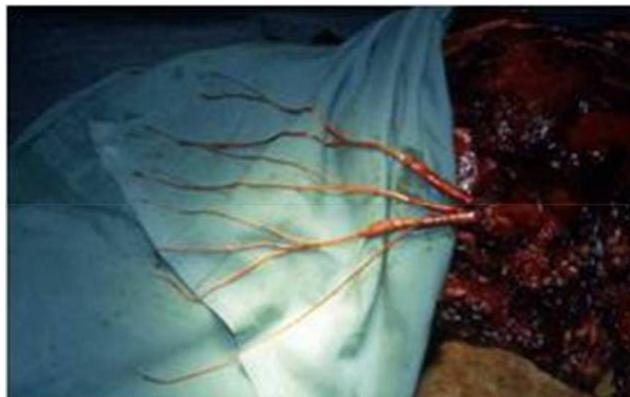
The amputated limb was covered with sterile gauze, then placed on a sterile tray and stored in a refrigerator at 4°C. Once the patient had been hemodynamically stabilized, it was decided to carry out an x-ray of the pelvis showing a remnant of the iliac crest and the left pubic symphysis (Figure 4).



**Figure 1:** Amputation of the left lower.



**Figure 2:** Exposure of the residue of the iliac crest with defined and regular margins.



**Figure 3:** Femoral nerve with its terminal roots.

The patient was transferred to the operating room and subjected to an exploratory laparotomy, during which the abdominal aorta was temporarily clamped in order to obtain greater proximal vascular control. The left iliac artery and vein were tied. The bladder was sutured at the intraperitoneal level, having probably ruptured during the violent impact and a resection of a portion of the descending colon was performed which showed loss of much substance with end-to-end anastomosis and proximal colostomy protection.



**Figure 4:** X-ray of the pelvis showing a remnant of the iliac crest and the left pubic symphysis.

A drain was subsequently inserted in the abdominal cavity and the remaining part of the left testicle was sutured, after which we placed some fat gauzes on the loss of substance in the left pelvic tear (Figure 5).

The patient underwent broad-spectrum antibiotic therapy intravenously (ceftriaxone and metronidazole) and analgesic (tramadol, ketorolac, morphine).



**Figure 5:** Gauzes on loss of substance in the left pelvic tear off.

Later, limb skin-flaps were removed from the amputee to use as grafts to cover the pelvic wound (Figure 6) because the complex structural lesions of local tissue led to packaging of flaps in the proximity (cross-flap) as in Lasurt and Combalia-Aleu [5].



**Figure 6:** Skin-flaps.

After 40 days in the emergency surgery department, and with an improved general condition, the patient was transferred to the department of dermatology and plastic surgery for surgical procedures.

The patient was discharged from hospital after 70 days in hospital and transported to a physical and psychological rehabilitation center.

## Discussion

The case presented is one of the rare events of traumatic hemipelvectomy, as it is an unusual type of lesion representing 0.6% of all pelvic fractures, although the lesions of the lower extremities are more usual than those of the upper extremities [6]. In fact, the lesions usually diagnosed in motorcyclists occur in the limbs (80.4%), and in particular fractures of the tibia and fibula are the most common (40% of cases), followed by lesions of the cephalic segment (15.5 %) and less frequently in the chest (5.5%) and abdominal (3.8%) districts, with an average survival of about 98%, as despite these incidents constitute the

most common it is noticeable that in heavy traffic there is less likelihood of serious injury [2,7]. In this particular case it is a traumatic hemipelvectomy because the left side of the pelvis is mangled; there is disruption of the pubic symphysis and sacroiliac joint in association with amputation of the lower left limb, the rupture of the iliac vessels and the serious injury of the femoral nerve [8]. Furthermore, even if there have been cases in the literature in which visceral injury did not occur, just as in 88% of cases as reported in studies, our patient has lesions in the genito-urinary and ano-rectal tract and soft tissue injury with wound contamination due to contact with the ground [6,9]. The mechanisms responsible for the injuries at limb level, as described in international cases, are the direct force, the lesion produced by the mobilization of bone fragment and third-degree burns, the latter due to the friction of the limb, by extended contact with a rough surface, but these cannot be responsible for the lesions present in our patient [7,10]. In fact, as regards the upper limbs there were excoriations, not burns, occurring due to the friction of the skin when in direct contact with the road surface and to bruising occurred following the fall, which resulted in the rupture of the capillaries with consequent extravasation of the blood in the surrounding tissues [10,11]. As reported in studies, the lesion mechanism that is responsible in 40% of cases of traumatic hemipelvectomy is attributable to the snap of the patient's knee against the bumper of the car, resulting in extreme abduction and external rotation in association with a high entity traction force that leads to an avulsion limb [12,13].

In our case the amputated limb appears completely intact (Figure 1) so the mechanism just described is not permissible. The mechanism responsible was a slither blow from the side of the car with the destruction of the pubic symphysis of the involved extremity and disruption of the remaining pelvic structures and the sacroiliac joint [14]. The left lower limb was supposedly uprooted as a result of the foot snaps in under the motorcycle, while the rest of the body was hurled from the vehicle [14].

The tractive force is responsible, in the case reported, for the soft tissue injuries that appear torn apart, while in studies it is shown that it may cause a deep tear in the perineum, which upon extending then posteriorly causes a rupture of the levator ani muscle and lesions of the colonrectum [15].

Another important factor is also involved in the determinism of such traumatic injuries, namely the quantity of energy that moves the limb itself, and this produces a more serious injury than the determining mechanism alone. The relative amount of energy absorbed by the tissues directly results in the quantity of bone destruction and that of all surrounding tissues, and then in mangled and left lower limb amputation [16,17]. In particular, in our case there was a large loss of substance by stripping with consequent damage of the vascular axis tunics, which made it impossible due to high likelihood of failure to proceed with an attempt aimed at reconstruction, repair and lesion coverage [18]. In medical literature it is argued that in cases where a significant vascularization failure appears, this also negatively affected the engraftment of skin grafts [19]. It should be emphasized that the damaged limb was the result of a high-energy trauma, and therefore also caused serious damage to vital organs, which was assessed before any therapeutic decisions were made [16]. In fact, the mangled limbs alone, by definition, involves at least three of the four systems (soft tissues, bones, nerves and blood vessels), which in our case are all involved, and this widespread involvement renders impossible any attempt at re-engagement [20].

The therapeutic and urgency surgical treatment, that changes over time with scientific progress, in this case was initially aimed at saving the life of the subject and not the limb. Despite advances in resuscitation in the care of wounds and the treatment potential for saving skin flaps and external fixation of bone fragments which today make it possible to save limbs, this was not possible in our case given that the tear-off injury and the vascular axes and extensive tissue laceration made the procedure of regrafting extremely risky. The decision not to replant the limb in the acute phase was difficult for the surgical team for several reasons, especially given the young age of the patient, which reinforced a strong desire to restore the patient's functional status of the limb as much as possible to that of pre-accident level [20-22]. The various literature case studies showed, however, that attempts to salvage the limb, subjecting the patient to great physical, psychological, financial and social suffering is subject to a very high risk of complications quod vitam, in particular sepsis syndromes and revascularization. It is also clear that both people with limb amputations who utilize prostheses, and those with a reconstructed limb have a similar disability, with a common rate of return to work of approximately 50%. What distinguishes the post-operative phase in the two different types of treatment are the complications, which occur the most (in 85% of cases) and more severely in reimplanted patients compared to amputees [16]. Specifically, the most common complications in amputees, which fortunately in our case did not occur, probably due to the type of antibiotic prophylaxis carried out and the adequate debridement, are infection, phantom limb pain, wound dehiscence and complications of the stump.

In replanted cases, however, the most serious early complication is severe multiorgan failure by revascularization which leads to a high mortality rate, while later phenomenon include more general infections, osteomyelitis, necrosis, or the separation of the grafted flaps and post-traumatic osteoarthritis, which in 5.4% of cases lead to subsequent amputation, after lengthy hospitalization [16,23]. In fact, studies show that even in cases where the limb remains connected to the pelvis with residues of structures (skin, muscles, tendons, etc.), before proceeding with any reparative surgical operations of any harmed internal organs, the general recommendation is to complete the hemipelvectomy, as hemostasis (control of hemorrhage is the initial and primary goal) and an adequate debridement are easier to realize, leading to fewer complications [24-27]. The limb of our patient was completely amputated, lying about 12 feet from the subject, so after drug therapy exploratory laparotomy was immediately carried out, which allowed us to safely perform hemostasis and then, once damage of internal organs was accurately identified, to rapidly proceed to repair them.

Regarding intestinal lesions from trauma the mechanisms are different and primarily include compression and deceleration forces. The result of the action of direct compression between the vertebrae and the anterior abdominal wall is a sudden increase in intraluminal pressure resulting in a rupture of the bowels. It has been seen that intraluminal pressures exceeding 150-260 mmHg are capable of producing blast lesions and a stripping of the intestinal loops [28]. The result of deceleration forces, however, entail the production of lesions at the level of the fixed points of viscera such as the duodenum and the right and left colon [28]. In this case, the anorectal lesions caused to the subject included anal plicae laceration, plausibly due to a distension of the organ and bulging structures sphincter tear-off, and muscle injuries to muscle, of which the most effected were the quadratus lumborum muscles, psoas major and cremaster Lasurt and

Combalia-Aleu [5]. All this suggests a very strong pull force at the level of the internal muscles of the left hip that first produced tearing of the muscles and then tore off part of the descending colon and the left testicle. This harmful mechanism, attributed almost exclusively and with justification to traction on the muscles, as despite the evident tear-off laceration at the muscular level, and in particular the laceration of the distal part of the psoas major muscle, there remained the in situ although frayed permanence of the femoral nerve with its termination point.

This is thus an exceptional case according to literature. In the case of abdominal trauma caused by a traffic accident the intestinal lesions, although quite common, here involve to a greater degree the transverse colon and the sigmoid colon because of their position, and are only rarely descending [29].

Regarding the bladder lesion (have been reported cases of indemned bladder), the series of international cases include three mechanisms that cause injury: sudden compression of the full bladder, direct cutting and lacerations from the stumps of the pelvic fracture [5,30]. The intraperitoneal bladder laceration suggests a blast of replete bladder for direct compression, probably occurring after the avulsion of the limb due to the fall on the ground, a fact that has called for immediate catheterization and early surgical repair by extramucosal stitches in order to minimize the risk of sepsis [31,32].

The permanent disabilities in these cases, and also in those younger (in Calonge et al. is described even a case of an 18-month-old girl), require treatment for years and provoke a substantial morbidity for a prolonged period of time [33].

In this case, they consist of the complete loss of the left lower limb and, in part, descending colon, testicular mutilation, the tearing off of anal folds and the sphincter apparatus, intraperitoneal rupture of the bladder and of the grafts.

The disability resulting from orthopedic pathologies is very significant [34]. As to the loss of the lower limb what should be considered in this case is not only the lack of the limb itself (as write Walcher et al. [35] and as has already been described by Osti et al. [36] "a leg, even if numb and paralytic, is still useful for sexual, urinary and anal functioning and has a significant impact on psychological adjustment"), but also the impossibility of movement and lack of stability in an upright position and in sitting. Indeed, in such conditions the lack of the limb requires 45% more energy than for the able-bodied [12].

To the above we must add that the harm suffered in the intestine causes the reduction of water reabsorption by increasing the speed of transit that causes malabsorption and frequent diarrhea which also accentuates the discomfort remnant to the sphincter injury, although subjected to functional rehabilitation. In addition, the damage sustained in the bladder, although currently not causing any functional impairment could lead over time to urinary incontinence from detrusor dyskinesia, causing a further deterioration in the quality of life [37-39].

To the disabilities described above, genital mutilation must also be added. Although this should not affect the reproductive activity of the patient, except for a slight hormonal imbalance that is generally offset by the contralateral testis, biological damage is coupled with an existential damage of considerable scope, because it will affect the social life of the young patient [40].

## Conclusion

With traumatic hemipelvectomy in young subjects difficulties arise, as described, both clinically, surgically and from a legal-medical perspective. Specifically here, medical-legal issues become manifest in our patient, especially in the allocation of the lesion mechanism, given that it departs from hemipelvectomy cases reported in the literature. The above is therefore reported as causing injury in its exceptionality and uniqueness, and the hope is that it may provide a valid support for a subsequent series of road accident rates of drivers of motorized two-wheel vehicles.

## Acknowledgment

The authors are grateful for the language revision to Profs Manuela Cipri (Dept. Political Sciences – University “Sapienza” of Rome) for her kind help.

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