

Patient was Injured by High Pressure Water Jet

Unlike many other injuries, those caused by high pressure water jet (HPWJ) must be **taken very seriously** and constitute a special variety of foreign matter interspersed. The injuries are frequently more extensive than they look, as a large amount of water can enter the body through a relatively small hole within short time and cause major damage there.

Due to the numerous types of injuries, which can be caused by HPWJ, the list below is restricted to some universally valid facts.

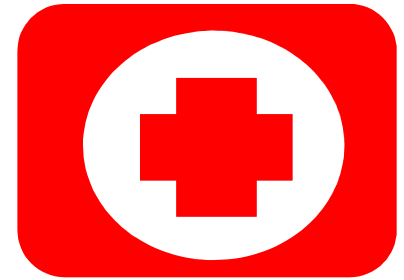
Possible Types of Injuries

Cuts

- Lacerated tissue, no large amount of damaged soft tissue, severed bone and amputated extremities or parts of extremities as a result.
(Possible cause: sharply focused jet of pure water or water containing abrasive substances, which was moved slowly across a part of the body)
- Incised tissue, seriously damaged tissue even at some distance from the wound due to the impact pressure produced.
(Possible cause: rapid movement of jet across a part of the body)

Contused (Crush) Injuries

- Injured area of the tissue around the jet entry point is enlarged.
- Crush injury of skin and destruction of deeper-seated anatomical structures. Due to the extensive damage to the tissue, wound healing is impaired. The damaged tissue should be surgically removed and then re-covered using suitable plastic surgery methods. (Possible cause: a fanned water jet)
- The externally visible damage is not suspicious at first glance. Bruises may appear and the area reacts increasingly painfully. Under its surface, the damaged muscle can swell and compress nerves and blood vessels (compartment syndrome). This can result in an extensive destruction of cell



Information for Medical Personnel

References:

Axmann, H.-D.; Flügel, M.; Laurinat, A.; Louis H. – Injury potential of high pressure water jets – 12th International Conference on Jet Cutting Technology – BHR Group Conference Series Publication No 13 – Mechanical Engineering Publications Ltd., London UK 1994

Axmann, H.-D.; Krause, M.; Laurinat, A.; Louis, H.; Meissner, T. – Damage mechanisms of injuries caused by high pressure water jets – 13th International Conference on Jetting Technology – BHR Group Conference Series Publication No. 21 – Mechanical Engineering Publications Ltd, London UK 1996

and muscle tissue. (Possible cause: the jet energy was too low to penetrate the skin)

- Damage to important organs, such as the brain, heart or liver. (Possible cause: the jet hit areas above important organs and transfer energy)

Damage caused by Contaminated Medium

A water jet that has passed through the skin transports foreign substances into the body, even if pure water was used as a medium. The injected particles can be microscopic in size. These substances spread in the tissue along muscles, nerves, tendons or blood vessels, or if the jet's course was deflected after hitting bone. The exact extent of the contamination can only be defined by extensive operative exposure.

Other Risks

Extensive and / or very painful injuries can be life-threatening as the patient may suffer a shock.

Working Principles of High Pressure Water Jet System

In a high pressure water jet system, a working medium – usually water – is compressed by a pressure generator and transported through pipes or tubes to a nozzle by which the high pressure is converted into fluid jet velocity. The operating jet speeds involved are the order of twice the speed of sound and are produced with system pressures of up to 300 MPa (3000 bar). The typical nozzle diameter for hand-operated jetting systems is 0,5 to 3 mm.

Summary

1. The skin can be penetrated by water jets even at a relatively low pressure of approx. 40 bar.
2. The jet can be deflected internally or intercepted by harder tissue and cause internal injuries.
3. A large amount of fluid can be injected within short time.
4. The first impression of the wound may be that it is superficial; however, it is possible for major damage to occur.
5. Foreign substances such as abrasives or impurities can be injected with the water and contaminate even deeper-seated tissues.

On-Site First Aid

- Elevate injured part of the body.
- Cover the wound with sterile material or bandage. Apply pressure bandage if it bleeds profusely.
- Keep the injured person under observation.
- Pack any severed body parts in a cloth or clean plastic bag and chill if possible.
- Transport to trauma surgery unit as quick as possible.