



WJA WATER JETTING INJURY TREATMENT ALGORITHM

The WJA Water Jetting Injury Treatment Algorithm® has been developed by Dr Sancho Rodriguez-Villar, the WJA's senior medical advisor, and Dr Robert Charles Kennedy (PhD), the WJA's clinical research coordinator, after they had led research, commissioned by the Water Jetting Association, into the causes and effects of water jetting injuries, notably high pressure fluid injection injuries.

The research is published in the European Journal of Emergency Surgery:
Eur J Trauma Emerg Surg. 2019 Jun;45(3):571-572

Dr Sancho Rodriguez-Villar LMS, MSc (EQF 7), PhD cum laude (EQF 8), EDIC, AFICM, an Intensive Care Consultant at King's College Hospital, London, strongly advises all parties to use the WJA algorithm to maximise the chance of recovery from injury and minimise the risk of life-changing injury or death.

Hydraulic fluid injection can occur at pressures as low as 7 bar, or 100 psi, far lower than the pressure achieved by many over-the-counter water jetting machines. Ultra-high-pressure jetting exceeds 1,700 bar, or 24,650 psi.

The WJA is the member organisation for water jetting in the UK. It represents contractors, equipment hirers, sellers, training bodies, and all stakeholders with an interest in water jetting. The WJA is also the UK's leading water jetting training provider. It has incorporated this algorithm into its codes of practice.

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FIRST AID AT SCENE Two approaches to follow

1.

S
A
F
E

Shout for help

Assess the scene and approach with care

Find the casualty and free them from danger

Evaluate the mechanism of injury, then the casualty

2.

**C-ABC (Catastrophic Bleeding – Airway, Breathing, Circulation)
as per ATLS® guidelines**

WATER JETTING TRAUMA FIRST AID

1. Apply direct pressure to bleeding wounds.
Where TRAUMA KIT(s) are available on site, apply pressure using a haemostatic agent (such as Quickclot® or Celox®) and a trauma bandage and/or tourniquet. Otherwise, apply pressure over the bleeding site and elevate the injured limb, where possible.
2. Pack any severed body parts in a sterile cloth or clean plastic bag and chill if possible.
3. Note the time of the injury, nature of the material in the jet and environment. i.e. sewer, industrial site, highway.
4. If clinical circumstance allows, and there is clean water available, wound irrigation should be done. Monitor vital signs if possible.
5. Keep warm, nil by mouth, and reassure casualty.

ARRANGE TRANSFER TO HOSPITAL

Arrange the urgent transfer/evacuation of the patient to a hospital/medical facility nearby in the first instance.

- Initiate evacuation planning at point of injury in advance in remote areas such as decks, large footprint chemical refineries, industrial sites, manufacturing sites or oil platforms.
- Confined space extraction protocols to be used, where necessary.
- An air ambulance is likely to be needed.
- An assessment by a trauma or vascular surgeon needs to be organised as quickly as possible.

**CLINICALLY UNSTABLE
- MULTIPLE WOUNDS**

GO TO

2

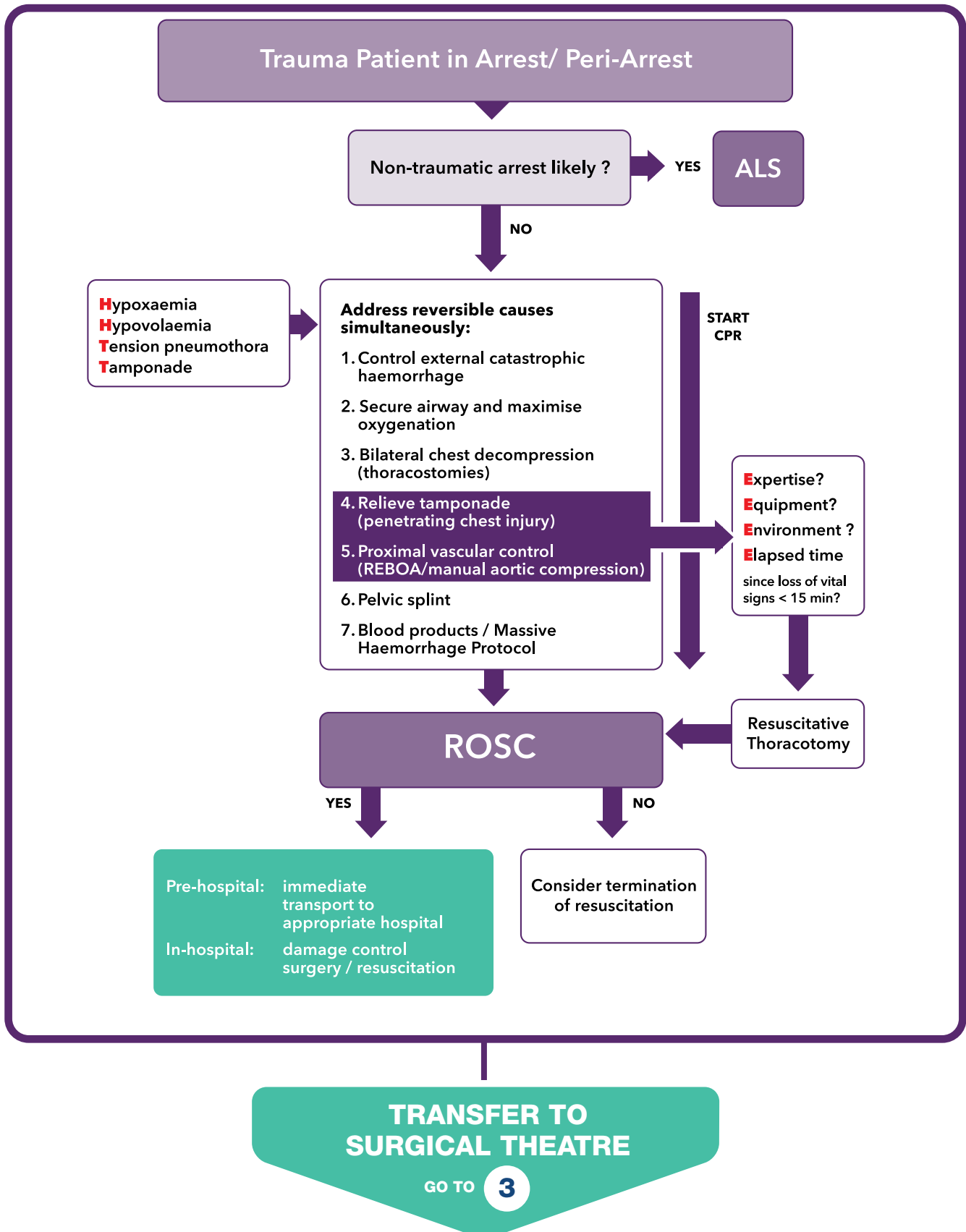
**CLINICALLY STABLE
TRANSFER TO A&E OR EMERGENCY DEPARTMENT**

GO TO

4

2

FIRST AID AT SCENE MAJOR TRAUMA



3

SURGICAL EMERGENCY
THEATRE

Arrange the urgent transfer/evacuation of the patient to a hospital/ medical facility nearby in the first instance.

1

Initial **DEBRIDEMENT** and **DECOMPRESSION** should start as soon as an experienced trauma surgeon is available.

2

WOUND SWABS and **TISSUE SAMPLES** should be taken and sent for microbiological and histological examination so the presence of fungal spores can be identified.

3

DECOMPRESSION FASCIOTOMY of all compartments must be one if the patient is having, or is at high risk of, compartment syndrome.

4

Tissue that is definitely avital must be removed. Traumatized but potentially surviving tissue will be evaluated in a '**SECOND LOOK**' 36-48 hours later.

5

In cases of contamination (often the case), manual wound **IRRIGATION** 3-9 L will be useful, with additives such as polyhexanide, octenidine or superoxidised water.

6

NEVER ATTEMPT PRIMARY CLOSURE, as this is a contaminated wound. Primary closure only in the case of certain decontamination and overall vitality of the wound. For high grade injuries, a temporary NPWT (negative pressure wound therapy) could be used until the earliest possible definitive plastic surgical wound closure.

TRANSFER TO DISCHARGE

GO TO 7

4

ACCIDENT & EMERGENCY / EMERGENCY DEPARTMENT

This is initially a **CONTAMINATED** injury which requires **EMERGENCY SURGERY** to be performed - until clinically proven otherwise.

Trauma team

- Handover: ATMIST (mechanism, injuries, signs and symptoms and treatment received).
- Primary assessment as per ATLS® guidelines (ideally by surgeon).
- If patient is in shock, all traumatic causes must be considered and treated.

Medical history

- Time of incident.
- Details of the contaminant. Check for paints or solvents and **Exclude** general intoxication.
- Past medical history.
- Allergies.
- Date of last tetanus injection.

Examination

- General examination.
- Examination of the injury site (note the size and site of the entry wound).

Check for local swelling, erythema and skin colour change. Assess the range of movement and tendons function (strength grade) and neurological weakness and numbness. Watch for compartmental syndrome. Wounds must not be surgically explored in ED.

**IF NECESSARY, TRANSFER
TO EMERGENCY SURGERY**

GO TO 3

**CONTINUE MEDICAL
INVESTIGATION**

GO TO 5

5

INVESTIGATIONS

ACCIDENT & EMERGENCY /
EMERGENCY DEPARTMENT

Arrange the urgent transfer/evacuation of the patient to a hospital/medical facility nearby in the first instance.

Investigations

- **Imaging:** If patient is haemodynamically unstable: EFAST/ portable pelvic X-ray and chest X-ray can be considered. If patient is haemodynamically stable: a CT-scan can be considered. Always obtain X-rays of the injured area to check for presence of subcutaneous air, foreign bodies or fractures. Preferably, obtain an urgent CT-angiogram scan.
- **Laboratory:**

Basal blood cultures
Cross match
Full blood account (FBC)
Arterial blood gas (ABG)
Urea & electrolytes (U&Es, BUN)

Liver function tests (LFT)
Direct (conjugated) bilirubin
Hepatitis screening A, B and C
Biochemistry
Basal procalcitonine

Clotting (including fibrinogen and calcium levels) especially if it is a haemorrhagic trauma
C-reactive protein and creatinine kinase (CK)

General Management

1. In isolated limb wounds, steroids if there is irritant material (petroleum-based products). Continue for a minimum of 24 hours or up to 7 days, depend of the case.
2. Hydrocortisone 200 mg/IV/ Stat, followed by 50 mg/6h/IV or prednisolone 0.5 mg/kg/OD. Currently, it is not advised on only water injuries.
3. Pain control: morphine boluses 2.5-5mg PRN or ketamine 50-100 mg (as required) IV and an anti-emetic such ondansetron 4-8 mg/6h/IV or cyclizine 50 mg/8h/IV.
4. Preoperative CT-angiogram is advisable IF possible. Distal pulse does not exclude arterial injury in these circumstances.
5. The patient should be taken to theatre for exploration of the injured limb.

IF NECESSARY, TRANSFER
TO EMERGENCY SURGERY

GO TO 3

SELECT ANTIMICROBIALS

GO TO 6

6

ANTIMICROBIALS

ACCIDENT & EMERGENCY /
EMERGENCY DEPARTMENT

- Tetanus status. If uncertain, vaccinate.

Avoid if severe penicillin allergy, seek specialist advice*	Antimicrobial prophylaxis	Comments
Patient presenting for immediate debridement after HPWJ injury <24h	Co-amoxiclav 1.2 g/IV/TDS Alternative for penicillin allergic patients: Cefuroxime* 1.5 g/IV/TDS for 5 days plus Metronidazole 500mg/ IV /TDS for 5 days	Extensive debridement essential. Send samples for culture and sensitivity. Modify treatment according to culture results. Assess need for MRSA cover in areas with high prevalence. Close monitoring and start antifungal if: <ul style="list-style-type: none"> Fungal hyphae are seen in tissue after debridement. Wound becomes infected/ necrotic tissue.
Patient presenting >24h after the injury or with established soft tissue infection	Piperacillin-Tazobactam 4.5g/IV/ TDS plus Posaconazole 400mg/IV/ OD Alternative for penicillin allergic patients: Ciprofloxacin 400mg/ IV/ BD plus Clindamycin 1.2 g/IV/QDS plus Posaconazole 400mg/IV/ OD	Extensive debridement essential. Send samples for microscopy, culture and sensitivity. Continue antibiotic treatment until first surgical debridement/ washout. Modify treatment according to culture results. Total duration will depend on extent of injuries and intra-operative findings.
Patient not responding or developing infection while on first line treatment	Meropenem* 1g/IV/ TDS Plus Vancomycin IV (adjust as required). Plus Posaconazole 400mg BD for 14 days	Extensive debridement essential. Send samples for microscopy, culture and sensitivity. Modify treatment according to culture results.

*Avoid in severe penicillin allergy. Seek specialist advice.

IF NECESSARY, TRANSFER
TO EMERGENCY SURGERY

GO TO

3

PREPARE FOR DISCHARGE

GO TO

7

7

PATIENT DISCHARGE

Thinking about discharging such a patient? **THINK TWICE!!!**

If discharging from A&E or ED – REMEMBER

Normal examination at this stage does not exclude serious and potentially limb-threatening complications developing.

Pain may not be present initially.

ACTIONS NEEDED

1. Without fail: keep the patient in observation for at least 24h before discharge.
2. Watch for early signs of infection.
3. Keep in mind the possibility of unusual organisms being present and compartmental syndrome developing.

If discharging from hospital ward**ACTIONS NEEDED**

- Encourage the patient to return to hospital if they experience loss of functionality, pain, fever, swelling or any other symptoms.
- Makes sure you arrange a follow up by the appropriate specialist.
- PLEASE, encourage the patient to contact the Water Jetting Association via its website (www.waterjetting.org.uk) or +44 (0) 2083 201090 for the most up-to-date treatment development and clinical research findings.

CONSIDER COMPLICATIONS

GO TO 8

8

COMPLICATIONS USUALLY PRESENT AFTER A WEEK

From surgical wound

1. Check results from **WOUND SWABS** and **TISSUE SAMPLES** taken and sent previously for microbiological and histological examination.
2. If unusual pathogens or any filamentous fungi are detected, liaise with infectious disease specialist for advise on management and antimicrobial treatment.
3. Consider urgent surgical review if patient deteriorates.
4. Consider **NEW DEBRIDEMENT** and **DECOMPRESSION** and closure by second intention.
5. For high grade injuries already on temporary NPWT (negative pressure wound therapy) there would be a need for a new “wash out”.
6. Use the earliest possible definitive plastic surgical wound closure.

Systemic presentation

- Unusual infections with micro-aerophilic organisms (usually GRAM negative) and fungal. Check for previous cultures.
- Leptospirosis (Weil’s disease) presents as a flu-like illness with severe headaches, fever, nausea, and sometimes aseptic meningitis. Classical triad involves: jaundice, renal failure, and haemorrhage.
- Check (IgM) ELISA. Hepatitis A, B, C.

**ADVISE SELF-REFERRAL TO
GP IF PATIENT HAS ANY CONCERNS**