Medical Implications of Less Lethal Weapons

Interim statement on the medical implications of the use of vehicle-mounted water cannon in a public-order role

Background

1. The role of the DSAC\(^1\) Sub-Committee on the Medical Implications of Less Lethal Weapons (DOMILL) is to provide the Secretary of State for Northern Ireland with:

   a. Advice on the medical implications of generic classes of less-lethal (LL) weapon systems (which includes biophysical, biomechanical, pathological and clinical aspects);

   b. Independent statements on the medical implications of use of specific LL systems, when used according to the formal guidance provided to users;

   c. Advice on the risk of injury from identified LL systems striking specific areas of the body, in a format that would assist users in making tactical decisions, and developing guidance to users to minimise the risk of injury.

2. This advice is in support of the UK Government’s requirements arising from:

   a. Recommendations 69 and 70 of the Patten Report into policing in Northern Ireland\(^2\): (i) a research programme to find an acceptable, effective and less potentially lethal alternative to the Baton Round, (ii) provision of a broader range of public-order equipment to the police;

   b. The desire of the Association of Chief Police Officers (ACPO) to have a wider range of options in conflict management scenarios, including those most commonly associated with self-defence and restraint, and the Police use of firearms.

   In summer 2000, the Secretary of State for Northern Ireland set up a UK-wide inter-departmental Steering Group to co-ordinate a programme to address both requirements.

3. The second report of the Steering Group has described the various classes of LL weapon systems being evaluated to address the requirements\(^3\). The report categorises the technologies according to the requirement for research and evaluation. Within

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\(^1\) Defence Scientific Advisory Council.


Category A (devices which may be subject to research and evaluation immediately) are vehicle-mounted and portable water cannon.

4. DOMILL was invited to provide a statement on the medical implications of the use of vehicle-mounted water cannon in public-order role, by October 2002. At a meeting of the Steering Group on 20 December 2001, DOMILL was requested to provide an interim statement by February 2002; at a subsequent meeting of the Steering Group in January 2002, this was extended to March 2002. The interim statement was required to facilitate the consideration of future water cannon use and in particular, the proposal for purchase of water cannon for use by the Police Service of Northern Ireland (PSNI). This document is the interim DOMILL statement.

Technical approach

5. In view of the short time-scales necessary to inform the procurement process, the Steering Group was advised by DOMILL that the statement could only be considered expedient. It would encompass a review of published medical and technical data, and of official reports on operational use of water cannon by UK and some European police forces. The statement would not be able to address detailed technical assessments of water cannon output, or experiments using physical or computer models of human injury. These tests would be undertaken subsequently on the water cannon identified for purchase.

6. The review of the literature and the assessment of the reported technical performance of specific water cannon were undertaken on behalf of DOMILL by the Defence Science and Technology Laboratory (Dstl). Over 500 references and web-sites were reviewed. The documents and web-sites addressed the use of water cannon and injuries attributed to that use, the physics of water jets, and injuries reported from the impact of water in other scenarios, such as water sports. Dstl reviewed the technical specification of some of the water cannon used recently in Northern Ireland, Belgium and Germany, and the specification of the water cannon to be purchased for future use in Northern Ireland.

Conclusions

7. On the basis of the review of a diverse body of literature – little of which had direct, substantiated relevance to the medical consequences of the operational use of water cannon or its use in training – the following conclusions are offered.

8. Deaths: There was no evidence in the peer-reviewed journals, press, police or fringe literature reviewed that any person has been killed by the direct or indirect effects of the impact of a jet from a water cannon in operational use. This conclusion encompasses injuries directly from the jet impact (primary injury), penetrating or blunt impact injuries form debris and street furniture accelerated by the jet (secondary injury) and the impact of the accelerated human body against solid objects or the ground (tertiary injury).
9. **Life-threatening injuries:** In the world-wide literature, there was an extremely low incidence of injuries that could be classed as life-threatening attributable to, or actually caused by water cannon jets. The Belgian and German police authorities, and the Police Service of Northern Ireland (PSNI) have no reports of serious or life-threatening injuries to the public that could be attributed to the jet of the Belgian Mol CY NV MSB 18 or the German Ziegler water cannon. It should be recognised however that the use of force of any nature carries a risk of injury.

10. In public-order incidents in which water cannon may be deployed, it may be difficult to differentiate injuries arising directly from its use, or from other potential sources of trauma such as batons, kinetic energy projectiles, assaults or irritants. This clouded the review of all sources of published information on the use of water cannon, and will have implications for assigning injuries arising from future deployments and use, in the subsequent audit.

11. **Water jet dynamics:** The behaviour of free water jets is complex. Although the bulk properties of a jet of water can be calculated (mass flow rate; average jet velocity), it is extremely unlikely that the effective loading on the body could be calculated from first principles. The distribution of energy in the jet (and thus risk of injury) can be altered by ostensibly minor changes in pump/nozzle characteristics, with little overt effect on bulk output. This has three consequences:

   a. The effective loads on the body must be determined experimentally;
   
   b. All evaluations must be undertaken on operational equipment, not prototypes or rigs;
   
   c. More than one example of each specific water cannon should be evaluated.

12. **Future vehicle-mounted water cannon:** It is currently unlikely that a water cannon built to the proposed specification of the PSNI would result in a notable change in probability or severity of injury (compared to that from existing water cannon) if used according to the extant PSNI guidance to users. This should not inhibit a review of the extant guidance to reduce the risk of injury from the currently deployed and future water cannon. In the light of the known complexity and variability of water jets, it is essential that the injury potential of the water cannon be verified experimentally.

**Recommendations**

13. **Guidance to users and training:** The impact of a high-pressure water jet from a water cannon is a high momentum event and may therefore lead to the displacement of the body. In certain scenarios (such as people close to solid obstacles), the potential for an increased risk of injury exists. Future guidance and training should reflect the risks arising from the displacement of people and objects.
14. **Future assessment:** DOMILL has been requested to deliver a final statement on the medical implications of the use of water cannon by October 2002. A formal technical plan for the experimental work to support the statement must await confirmation of the availability for testing of existing and future water cannon equipment. At this stage, it is envisaged that the scope of the programme may encompass:

   a. Measurement of the gross fluid output of both the Mol CY NV MSB 18 water cannon, and the new water cannon proposed to be procured by the PSNI;

   b. Definition of the biologically effective loading within the jets;

   c. Measurement of the contact velocity and acceleration of the head with a rigid object such as a wall or the ground;

   d. Measurement of the initial linear and rotational acceleration of the head/neck assembly following direct or sweeping interaction of the jet with the head, and with the torso;

   e. The distribution of representative debris accelerated by the cannon directed to the ground, and the probability of specific injuries such as ocular trauma;

   f. The risk of primary injury to the torso and head assessed using computer or physical models.