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## The Power of High Explosives in a Confined Space

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When the awesome power of high explosives is unleashed

**Tom Clonan**

**ANALYSIS:** When terrorists bomb packed trains, the injuries are horrific, reports **Tom Clonan**

The bombs that ripped through three Spanish commuter trains yesterday were especially lethal when detonated in such a confined space. The type of explosives used would appear to have been high-explosive devices of a type used previously by terrorist groups such as Eta and the Provisional IRA.

Indeed, Spanish police foiled an attempt to place a 25kg high-explosive device on the regional San Sebastian-Madrid train as recently as December of last year.

Such devices are simply assembled and consist of three main components. The bulk explosive charge in such devices is normally a plastic explosive such as Semtex, or a western military explosive such as C4 or P4. All such explosives are nitrogen-based and contain nitroglycerine or nitrocellulose.

Plastic explosives are highly stable and malleable. They can be shaped to fit suitcases or hold-alls or even moulded to fill innocuous everyday objects such as children's toys or within the packaging of ordinary retail products; the type of object that would be commonplace on a packed commuter train.

These bulk charges require a powerful shock-wave to detonate them.

This shock-wave is delivered by the detonator. Detonators of the type favoured by groups such as Eta consist of highly sensitive high explosives such as mercury fulminate or lead styphnate.

These substances are detonated by a power source, normally a household battery, activated by a simple timer. In the case of the Madrid bombs, the timers may have been set to coincide with the timetabled arrival of the three trains at

the busy stations of El Pozo, Santa Eugenia and Atocha.

Had the bombs detonated alongside these crowded platforms, the death toll would have been much higher.

When the timer activates the power source, the battery heats a thin wire filament, not unlike the element in a kettle. This creates enough heat energy to activate the sensitive detonator. This in turn creates a shock wave which detonates whatever bulk explosive is being used.

Explosives such as Sementex, C4 or P4 detonate in a spectacular fashion. The shock wave functions to instantaneously convert the solid explosive into a gaseous form many thousands of times its original volume. This in turn releases energy in the form of light, heat and a devastating shock wave or blast.

The explosives detonated on the Spanish commuter trains yesterday would have generated a flash of heat and light with temperatures of up to 2,000 degrees. The shock wave or blast wave would have travelled through the confines of the carriage at speeds of between 2,000 and 4,000 metres per second.

The flash effect of such an explosion would immediately incinerate any commuters within a few metres' radius of the detonation. The shock wave within a confined space such as a train carriage would compress people's internal organs.

In such circumstances any commuters in close proximity to the blast would, in the argot of the military, have their internal organs "pulped" instantly. Those a little farther from the blast would instantaneously lose soft-tissue organs such as eyes and eardrums.

Other injuries resulting from the blast wave would include limb separation or amputation. Any commuters cradling infants would have been unable to hold their children against the force of the shock wave. In such cases, infants would be expelled from the carriage by being

blown through windows or other apertures along with escaping gases.

In addition to these effects would be the fragmentation effect of the shock wave on the skin of the train carriage and the internal fittings and fixtures. In such conditions fragmented seats, hand-rails and signage would form a wave of shrapnel functioning to inflict "gross blunt trauma" or major lacerations on anyone within range of the blast.

Many terrorist groups, including suicide bombers in Israel, seek to further exploit this effect by surrounding the bulk explosive with ball-bearings, nails or shards of metal in order to generate a "chain-shot" effect.

In parallel with these effects, the heat generated by the explosion would instantly ignite any flammable materials within range of the blast such as diesel fuel, interior and exterior paint and the component parts of seating and floors.

All of these effects combined will have seriously complicated the work of rescue workers and medical personnel. The high mortality rate will be accelerated in the coming days, with victims of the blast suffering from multiple lacerations and inner organ damage.

The massive blood loss associated with such injuries will have resulted in multiple cases of hypovolaemic shock leading to total collapse of the cardiovascular system and cardiac arrest. Frantic attempts at triage and appeals for blood over the coming days may well save lives.

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