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Fatal accidents in agriculture: reconstruction of dynamics and application of a technical pattern for the cause - effect analysis in tractors rollovers

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Introduction

Agriculture is at high risk for occupational accidents. More than 50% of fatalities occurring in Italy during agricultural activities are related to the uncorrected use of agricultural machineries (INAIL 2014). Data pertaining agriculture fatalities are often not updated and are underestimated due to the presence of unofficial workers (Pessina 2009). Near 150 workers die in Italy yearly while using agricultural machineries, more than 15% of all occupational accidents in Italy (Cividino 2015). Investigations on agricultural accidents are crucial in order to clarify the relation between lesions and machineries employed and to improve the use of safety devices. The most severe accidents are related to the use of agricultural tractor, which is widely used but has technical and structural criticism, in particular concerning overturn. (Figure 1)

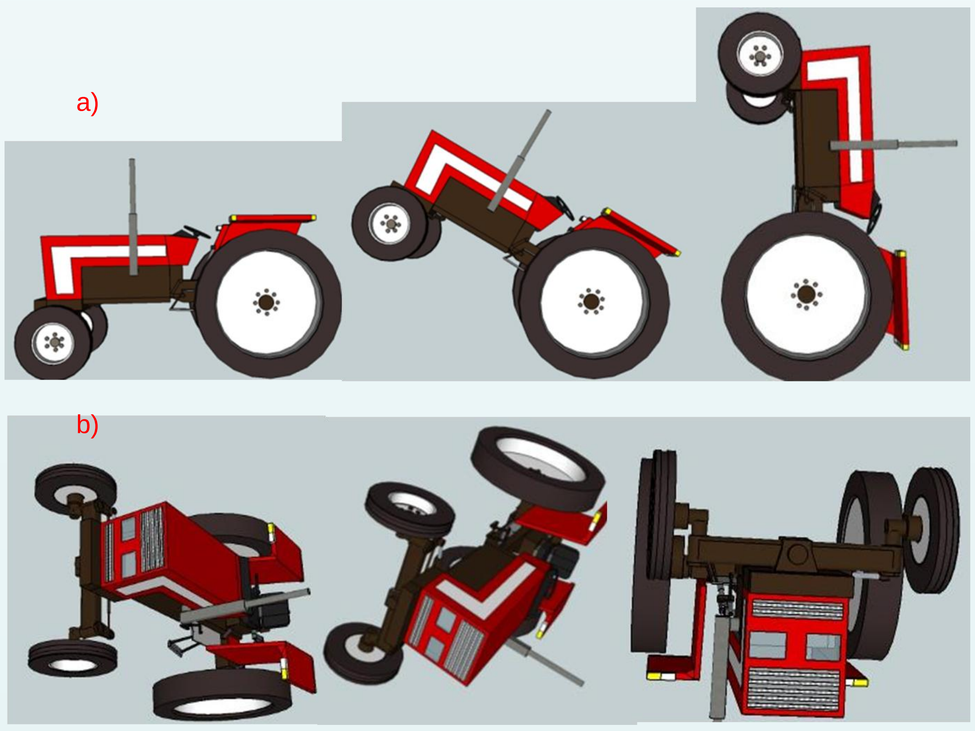

Figure 1 - Most frequent patterns of overturning at risk for fatal accidents
a) Longitudinal overturn b) Transversal overturn

Our study planned a structured pattern for the medico legal and technical analysis of agricultural accidents.

Materials and Methods

The study started in 2012, and included 5 phases:

- Analysis of agricultural deaths recorded in the register of post-mortems of the Legal Medicine Section of the University of Udine
- Description and coding of lesions found during medico legal external examination
- Analysis of the dynamics of tractor overturns
- Comparison of typical lesions found in the accidents and technical analysis of the machinery (mechanics, dimensions, weight, power) (Figure 2)
- Testing and applying the pattern on accidents and deaths happened in Friuli Venezia Giulia region.

Figure 2 – Application of the methodology by comparing technical characteristics and lesions

Results

By applying the methodology it was possible to obtain two main results: the first was relating cause and effect by matching technical characteristics of the machine with the results of medico legal external examination and autopsy, in order to reconstruct the dynamics. (Figure 3)

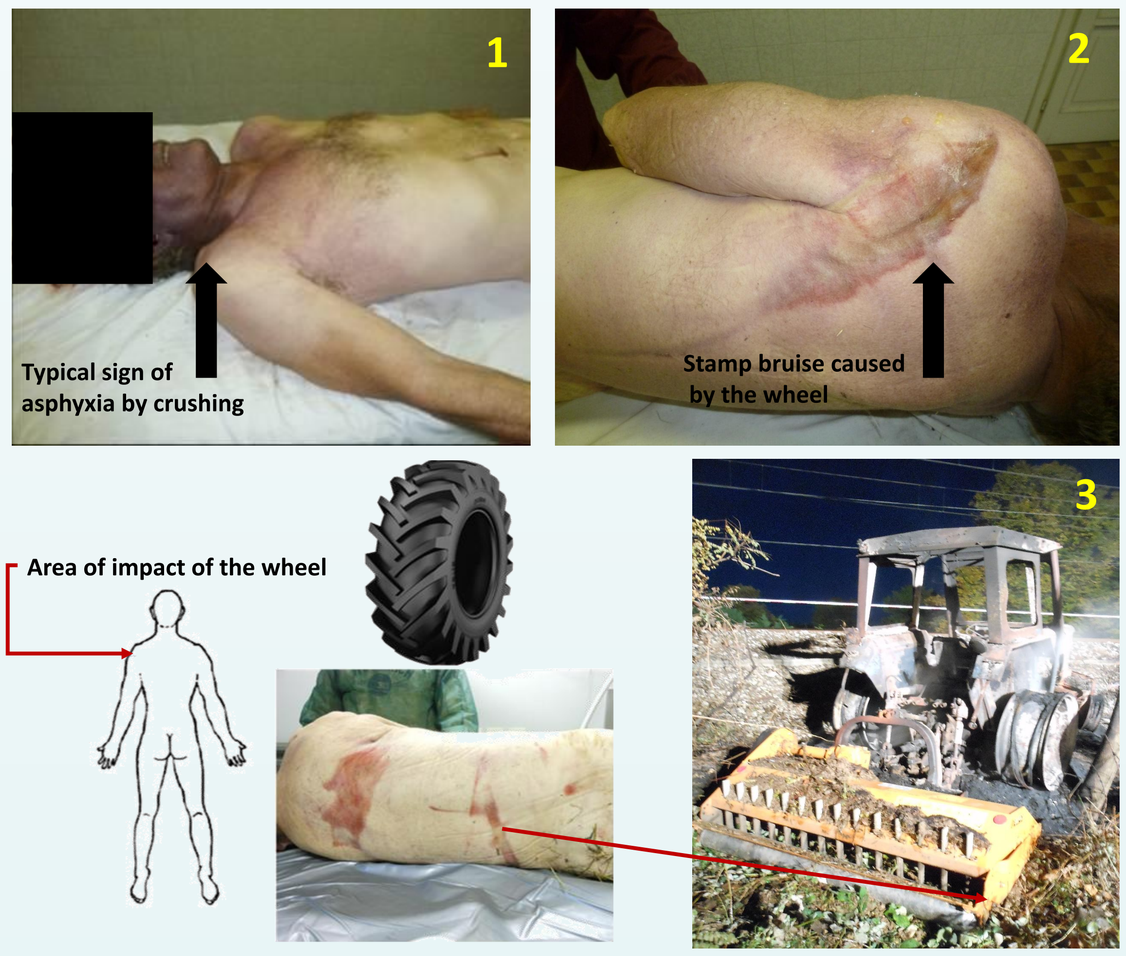

Figure 3 – Medico legal elements compared with technical characteristics of the machinery: ecchymotic mask due to asphyxia by crushing in overturn (1); stamp bruises caused by wheels and operative machine (2, 3)

The second result was creating a pattern which allows to reconstruct the dynamics by analysing technical aspects (ROPS, safety belts, type of tractor) and external and internal lesions. This instrument has a critical importance in cases when the corpse is found alone and isolated, many hours after the accident. (Figure 4)

Scenario	Categoria di macchina	R	C	Cabina	Dinamica finale e lesività attesa condizioni in piano	Dinamica finale e lesività attesa condizioni in pendenza o con ribaltamenti multipli	Possibilità di ustioni/contatto con parti calde	Esito evento	Parte colpita	Note
5	C2	No	No	No	Lesioni traumatiche a livello del capo e degli arti superiori nel contatto col terreno; possibili lesioni ecchimotico-escoriate estese, anche a stampo, nel contatto con parti del mezzo. Se nella dinamica l'operatore viene spinto in avanti, possibili traumi da compressione e schiacciamento a livello addominale.	Possibile proiezione, con rischio di traumi al capo e agli arti superiori nella caduta (rilevante l'altezza del mezzo). Se l'operatore resta in prossimità o all'interno del mezzo, traumi gravi da schiacciamento possibili in tutti i distretti, con eventuali lesioni anche a stampo riferibili alle parti del mezzo (rilevante anche la grandezza delle ruote).	Possibile contatto con parti calde, in particolar modo con la marmitta. Zone maggiormente a rischio viso e arti superiori.	Ad alta probabilità di esito mortale o di lesioni invalidanti, con possibilità di sopravvivenza temporanea e successiva morte per le lesioni degli organi interni (es. lacerazioni epatiche, spleniche, strappamento dei vasi per aumento pressorio). Possibile quadro da precipitazione se il mezzo supera i 2 metri.	Tutto il corpo	La massa del mezzo e le forze che intervengono in caso di ribaltamento rendono più probabile un decesso pressoché immediato

Scenario 5 nel modello QPDS

- Nessun ROPS;
- Cintura di sicurezza NON allacciata;
- Nessuna Cabina.

Figure 4 – Technical pattern to compare lesions and structural elements of the tractor

Conclusions

This work defines and analyses the risks related to the agricultural activities which involve tractors.

The analysis of medico legal aspects and technical elements reveal the severity of the lesions and the quickness of death, because of the relevance of masses and weights.

The proposed pattern is a useful instrument both for forensic and technical analysis, in order to reconstruct dynamics and to plan and improve the prevention of accidents.