



## Severe seizures in pigs naturally infected with *Taenia solium*

Trevisan, Chiara; Mkupasi, Ernatus Martin; Ngowi, Helena; Forkman, Björn; Johansen, Maria Vang

*Publication date:*  
2015

*Document version*  
Publisher's PDF, also known as Version of record

*Citation for published version (APA):*  
Trevisan, C., Mkupasi, E. M., Ngowi, H., Forkman, B., & Johansen, M. V. (2015). *Severe seizures in pigs naturally infected with Taenia solium*. Abstract from 1st CYSTINET International Conference, Belgrade, Serbia.

1ST CYSTINET INTERNATIONAL CONFERENCE  
TAENIOSIS AND CYSTICERCOSIS: A ONE HEALTH CHALLENGE

**CYSTINET**  
EUROPEAN NETWORK ON TAENIOSIS/CYSTICERCOSIS

**cost**  
EUROPEAN COOPERATION  
IN SCIENCE AND TECHNOLOGY

**PROGRAMME  
AND  
ABSTRACT BOOK**

  
University of Belgrade  
Institute for Medical Research

03-04 November 2015  
Belgrade, Serbia



1ST CYSTINET INTERNATIONAL CONFERENCE  
TAENIOSIS AND CYSTICERCOSIS: A ONE HEALTH CHALLENGE



# PROGRAMME AND ABSTRACT BOOK



03-04 November 2015  
Belgrade, Serbia

*Prepared by*  
**Ivana Klun**  
**Olgica Djurković-Djaković**



**University of Belgrade  
Institute for Medical Research**

## SCIENTIFIC COMMITTEE

**Pierre Dorny**

*Institute of Tropical Medicine,  
Belgium*

**Alberto Allepuz**

*CReSA, Spain*

**Manuela Vilhena**

*ICAAM, Évora University, Portugal*

**Sarah Gabriël**

*Institute of Tropical Medicine,  
Belgium*

**Maria Vang Johansen**

*University of Copenhagen, Denmark*

**Brecht Devleesschauwer**

*Ghent University, Belgium*

## ORGANISING COMMITTEE

**Sarah Gabriël**

*Institute of Tropical Medicine, Belgium*

**Olgica Djurković-Djaković**

*IMR, University of Belgrade, Serbia*

**Manuela Vilhena**

*ICAAM, Évora University, Portugal*

**Minerva Laranjo**

*CReSA, Spain*

**Ivana Klun**

*IMR, University of Belgrade, Serbia*

**Olga Dulović**

*Clinic for Infectious and Tropical Diseases,  
CCS, Serbia*

**Branko Bobić**

*IMR, University of Belgrade, Serbia*

**VENUE:  
PALACE Hotel  
Topličin Venac 23  
Belgrade**

## PROGRAMME

**Pre-Conference** (for CYSTINET members only):

Monday, 02 November 2015:

**08:30-09:00** Registration

**09:00-15:30** 2<sup>nd</sup> Working Groups Meeting: 6<sup>th</sup> floor “Beogradska panorama” conference hall

1<sup>st</sup> floor banquet hall

Mid-floor salon

~ **11:00** Coffee break

**13:00-14:00** Lunch: Ground floor restaurant

**16:00-18:00** 2<sup>nd</sup> Management Committee Meeting: 1<sup>st</sup> floor banquet hall

### Conference Programme

Monday, 02 November 2015:

**18:00** Registration & Welcome drink: 6<sup>th</sup> floor “Beogradska panorama” conference hall

Tuesday, 03 November 2015:

**08:30-09:30** Registration

**09:30** Welcome

**09:50** Session 1: **EPIDEMIOLOGY (WG1)**

WG1 presentation: B. Devleeschauwer and A. Allepuz

Invited speaker: J. Conlan, Food standards Australia New Zealand

**10:40** Coffee break

**11:00-12:30** Abstract presentations

**11:00** *Taenia hydatigena* in pigs: a systematic review and results from a cross sectional abattoir study in Burkina Faso (page **13**)

P. Dorny, B. Ouedraogo, Nguyen Thi Thuy Man, R. Ganaba, V. Dermauw, H. Carabin, S. Gabriël

**11:15** Factors influencing transmission of porcine cysticercosis in Tanzania (p. **14**)

U. Ch. Braae, W. Harrison, P. Magnussen, F. Lekule, M. Vang Johansen

**11:30** Geospatial and age-related patterns of *Taenia solium* taeniasis in the rural health zone of Kimpese, Democratic Republic of Congo (p. **15**)

J. Madinga, K. Kanobana, Ph. Lukanu, E. Abatih, S. Baloji, S. Linsuke, N. Praet, S. Kapinga, K. Polman, P. Lutumba, N. Speybroeck, P. Dorny, W. Harrison, S. Gabriel

**11:45** Age-related patterns of polyparasitism with *Taenia solium*, schistosomes and soil-transmitted helminths in a co-endemic village of Democratic Republic of Congo (p. **16**)

J. Madinga, K. Polman, K. Kanobana, L. van Lieshout, E. Brienens, N. Praet, C. Kabwe, S. Gabriël, P. Dorny, P. Lutumba, N. Speybroeck



**12:00** Epidemiological study in *T. solium* and *T. saginata* larvae infestation in pigs and cattle from Romania (p. **17**)

A-M. Oleleu, C. Gherman, A. Cozma, I. Oleleu, V. Cozma

**12:15** Epidemiology, impact and control of bovine cysticercosis in Europe: a systematic review (p. **18**)

M.Laranjo-González, B. Devleeschauwer, S. Gabriël, P. Dorny, A. Allepuz

**12:30-13:30** Lunch: Ground floor restaurant

**13:30** Session 2: **DIAGNOSTIC TOOLS (WG2)**

WG2 presentation-diagnostics part: T. Garate and P. Dorny

Invited speaker: S. O'Neal, Oregon Health & Science University, USA

**14:20-15:05** Abstract presentations

**14:20** Sensitivity of partial carcass dissection for assessment of porcine cysticercosis at necropsy (p. **19**)

M.W. Lightowers, E. Assana, C. Jayashi, C.G. Gauci, M. Donadeu

**14:35** Molecular diagnosis of Taeniasis/Cysticercosis complex: Analytical sensitivity of real time PCR based on HDP2 and Ptsol9 repetitive sequences (p. **20**)

M.Flores-Chavez, C. Domínguez-Hidalgo, Y.Monje, G.Molini, S. Martinez, T. Garate

**14:50** Improving LAMP assays for molecular detection of *Taenia* species (p. **21**)

L. Megido, T. Gárate, A. Muro, M. Flores-Chavez, M.J. Perteguer, J. López-Abán, P. Fernández-Soto

**15:05-15:25** Coffee break

**15:25-17:30** Session 3: **CONTROL (WG3)**

WG3 presentation: M.V. Johansen and E. Papadopoulos

Invited speaker: S.Boisson, WHO, Water Sanitation Hygiene and Health

**16:15-17:00** Abstract presentations

**16:15** CystiSim - an agent-based model for *Taenia solium* transmission and control (p. **22**)

U.Ch. Braae, B. Devleeschauwer, S. Gabriël, P. Dorny, N. Speybroeck, P. Magnussen, M. Vang Johansen

**16:30** Effect of repeated mass drug administration with praziquantel and track and treat of taeniosis cases on the prevalence of taeniosis in *Taenia solium* endemic rural communities of Tanzania (p. **23**)

U.Ch. Braae, P. Magnussen, B. Ndawi, W. Harrison, F. Lekule, M. Vang Johansen

**16:45** Starting new strategies of investigation on cysticercosis: systematic review of Taeniasis/cysticercosis and perspectives in Cote d'Ivoire (p. **24**)

A.T. Offianan, E. Koffi, O. M Boka, D. Cisse, A. Meite, K.E. Angora, M.K. Soumahoro, B. Assi, J. Djaman, R. Jambou

**17:00-17:30** *Galvmed presentation*

Update on treatment and vaccination of porcine cysticercosis

A. Colston

**17:30-18:30** *Poster session* (viewing & discussion)

- Rare case of taeniasis in the Istrian region (p. **31**)

L. Lazarić Stefanović

- The societal cost of *Taenia solium* cysticercosis in Tanzania (p. **32**)

C. Trevisan, B. Devleeschauwer, V. Schmidt, A.S. Winkler, W. Harrison, M. Vang Johansen

- Biosecurity on pig farms (p. **33**)

J. Bojkovski

- Introducing a new inter-disciplinary network on *Taenia solium* cysticercosis and taeniosis research in sub-Saharan Africa CYSTINET – Africa (p. **34**)

V. Schmidt, H. Ngowi, B. Ngowi, S. Mfinanga, C.S. Sikasunge, I.K. Phiri, K.E. Mwape, E. Normahomed, B. Brügge, C. Prazeres da Costa, A.S. Winkler

- Taeniosis in Serbia: changing trend over a 35-year period (p. **35**)

Z. Dakić, M. Korać, B. Brmbolić, N. Mitrović, I. Milošević, J. Malinić, A. Marković, S. Jovanović, O. Djurković-Djaković

- Slaughterhouse surveillance of bovine and porcine cysticercosis in Catalonia (2008-2014) through SESC: the slaughterhouse support network (p. **36**)

E. Vidal, M. Laranjo-González, E. Tolosa, A. Allepuz, A. Marco, L.L. Picart, M. Domingo

- Taeniosis diagnosed during last 15 years in National Centre for Epidemiology, Budapest, Hungary (p. **37**)

L. Kucsera, J. Danka, E. Orosz

- Molecular identification of zoonotic tissue-invasive tapeworm larvae other than *Taenia solium* in suspected human cysticercosis cases (p. **38**)

D. Tappe, J. Berkholtz, U. Mahlke, H. Lobeck, T. Nagel, A. Haeupler, B. Muntau, P. Racz, S. Poppert

- Outbreak of bovine cysticercosis on a cattle farm in Slovenia in 2015 – a case report (p. **39**)

A. Vergles-Rataj, B. Krt, J. Starič, J. Ježek, P. Dorny, S. Gabriěl, B. Šoba

- Cysticercosis at the slaughterhouses of the Braničevo district, Serbia (p. **40**)

M. Živojinović, S. Stokić Nikolić, D. Rogožarski, M. Lazić, I. Dobrosavljević, G. Rajković, S. Paunović

**1ST CYSTINET INTERNATIONAL CONFERENCE  
TAENIOSIS AND CYSTICERCOSIS: A ONE HEALTH CHALLENGE – Belgrade 2015**

---

**20:00 Conference dinner:** Skadarlija (downtown Bohemian district)

*Wednesday, 04 November 2015:*

**08:30: Session 4: NCC MANAGEMENT (WG2)**

WG2 presentation-NCC/T, case management: A. Winkler

Invited speaker: C. Coyle, Albert Einstein College of Medicine, USA

**09:45-10:25** Abstract presentations

**09:45** Characterizing human cysticercosis in Portugal 2006-2013 (p. **25**)

M. Vilhena, A.G. Fonseca, J.R. Marques da Silva, S.S. Dias, J. Torgal

**10:00** Treatment of neurocysticercosis in Serbia (p. **26**)

O. Dulović

**10:15** Human cysticercosis in Serbia – a 25 year national study (p. **27**)

B. Bobić, Z. Dakić, I. Klun, A. Nikolić, O. Dulović, V. Turkulov, O. Djurković-Djaković

**10:25-10:40** Coffee break

**10:40-11:10** Abstract presentations

**10:40** Cognitive impairment and quality of life of people with epilepsy and neurocysticercosis in Zambia (p. **28**)

A. L. Nau, K.E. Mwape, J. Wiefek, K. Schmidt, E.N. Abatih, P. Dorny, N. Praet, C. Chiluba, H. Schmidt, I.K. Phiri, A.S. Winkler, S. Gabriël, J. Blocher

**10:55** Severe seizures in pigs naturally infected with *Taenia solium* (p. **30**)

C. Trevisan, E.M. Mkupasi, H. Ngowi, B. Forkman, M. Vang Johansen

**11:10-12:00:** Round table discussion with all invited speakers, WG leaders, chair & vice

**12:00-13:00:** Lunch: Ground floor restaurant

**13:00–19:00: Farm visit**

# **ABSTRACTS**



## ***Taenia hydatigena* in pigs: a systematic review and results from a cross sectional abattoir study in Burkina Faso**

Pierre Dorny<sup>1</sup>, Boubacar Ouedraogo<sup>2</sup>, Nguyen Thi Thuy Man<sup>3</sup>, Rasmané Ganaba<sup>2</sup>,  
Veronique Dermauw<sup>1</sup>, Hélène Carabin<sup>4</sup>, Sarah Gabriël<sup>1</sup>

<sup>1</sup> Department of Biomedical Sciences, Institute of Tropical Medicine, Antwerp, Belgium

<sup>2</sup> AFRICSanté, Bobo-Dioulasso, Burkina Faso

<sup>3</sup> National Center for Veterinary Diagnosis, Hanoi, Vietnam

<sup>4</sup> Department of Biostatistics and Epidemiology, College of Public Health, University of Oklahoma Health Sciences Center, United States  
pdorny@itg.be

*Taenia hydatigena* is a non-zoonotic tapeworm transmitted between dogs, and ruminants and pigs. The metacestode larval stage is a large cysticercus that develops in the abdominal cavity. The parasite has clinical and economic significance, mainly in sheep, but is mostly an accidental finding at slaughter. However, its presence is causing cross-reactions in serological tests for *T. solium* cysticercosis in pigs. We performed a systematic review on its global occurrence in pigs. Analysis of literature results indicated a higher prevalence in pigs in Asia (17.35 % (95% CI: 10.63-27.04%)) and South America (27.48% (95% CI: 20.76 – 35.37%)) than in Africa, 3.94% (95% CI: 1.91-7.93%). More studies on *T. hydatigena* in pigs in Africa are required to confirm the validity of serology in *T. solium* epidemiological and control studies. We performed a cross-sectional study in the abattoir of Koudougou, Burkina Faso, to determine the prevalence of *T. hydatigena* in village pigs. We examined 452 pigs by inspection of the liver, omentum and visceral surface. *T. hydatigena* cysticerci were found in the liver of 25 pigs, in the abdomen of 12, and in both in one animal. Meat inspectors found 7 carcasses infected with *T. solium* cysticerci of which 6 were confirmed by molecular analysis. Seven cysts found in the liver were molecularly identified as *T. solium*. Overall, 40 carcasses (8.85%) were infected with *T. hydatigena*; *T. solium* was found in 13 animals (2.88%) and 2 pigs had mixed infections. The relatively high prevalence of *T. hydatigena* in this study suggests that serological results for *T. solium* should be interpreted cautiously. In studies using serology, the validity of positive results should be confirmed by post mortem examination. The *T. solium* numbers found in this study do not represent accurate prevalence figures as routine meat inspection has a low sensitivity, and tongue inspection positive pigs are mostly diverted to the unofficial slaughter circuit.

## Factors influencing transmission of porcine cysticercosis in Tanzania

Uffe Christian Braae <sup>1</sup>, Wendy Harrison <sup>2</sup>, Pascal Magnussen <sup>1</sup>, Faustin Lekule <sup>3</sup>,  
Maria Vang Johansen <sup>1</sup>

<sup>1</sup> University of Copenhagen, Denmark

<sup>2</sup> Imperial College London, United Kingdom

<sup>3</sup> Sokoine University of Agriculture, Tanzania

braae@sund.ku.dk

Understanding the factors contributing to the transmission of *Taenia solium* in sub-Saharan Africa is essential for control. This study aimed to elucidate factors concerning the transmission of porcine cysticercosis in an endemic area. A longitudinal study composed of three cross-sectional surveys (March/April 2012, October/November 2012, and July/August 2013) and a case-control study (July 2014) were carried out in Mbeya Region, Tanzania. During the cross-sectional surveys venous blood was collected from pigs in 22 villages and analysed for porcine cysticercosis by Ag-ELISA (B158/B60). The case-control study consisted of questionnaire interviews and observational surveys of study households, that were allocated into cases or controls based on porcine cysticercosis presence or absence in the cross-sectional surveys. This resulted in 43 farmers in the case group and 50 farmers in the control group. In each cross-sectional survey between 800–1000 serum samples were collected. This revealed seasonal fluctuation in cysticercosis prevalence from 15% during baseline, to 24% ( $p < 0.001$ ) in the 6-month follow-up, and down to 20% ( $p = 0.053$ ) in the 14-month follow-up. Based on logistic regression porcine cysticercosis could be associated with absence or completely open latrines ( $p = 0.035$ , OR 5.98, CI: 1.33- 43.02) compared to enclosed latrines, and feeding potato peels to pigs ( $P = 0.007$ , OR 3.45, CI: 1.43-8.79). Prevalence of porcine cysticercosis fluctuated throughout the seasons, and confined pigs did not have lower sero-prevalence compared to free roaming pigs, supporting transmission from feedstuff. A One Health approach including improved sanitary conditions and pig management is needed to obtain control of *T. solium*.

## **Geospatial and age-related patterns of *Taenia solium* taeniasis in the rural health zone of Kimpese, Democratic Republic of Congo**

Joule Madinga, Kirezi Kanobana, Philippe Lukanu, Emmanuel Abatih, Sylvain Baloji, Sylvie Linsuke, Nicolas Praet, Serge Kapinga, Katja Polman, Pascal Lutumba, Niko Speybroeck, Pierre Dorny, W. Harrison, Sarah Gabriel

Institute of Tropical Medicine, Antwerp; Université catholique de Louvain  
jmadinga@yahoo.fr

*Taenia solium* infections are mostly endemic in less developed countries where poor hygiene conditions and free-range pig management favor their transmission. Knowledge on patterns of infections in both human and pig is crucial to design effective control strategies. The aim of this study was to assess the prevalence, risk factors and spatial distribution of taeniasis in a rural area of the Democratic Republic of Congo (DRC), in the prospect of upcoming control activities. A cross-sectional study was conducted in 24 villages of the health zone of Kimpese, Bas Congo Province. Individual and household characteristics, including geographical coordinates were recorded. Stool samples were collected from willing participants and analyzed using the copro-antigen enzyme-linked immunosorbent assay (copro-Ag ELISA) for the detection of taeniasis. Blood samples were collected from pigs and analyzed using the B158/B60 monoclonal antibody-based antigen ELISA (sero-AgELISA) to detect porcine cysticercosis. Logistic regression and multilevel analysis were applied to identify risk factors. Global clustering and spatial correlation of taeniasis and porcine cysticercosis were assessed using K functions. Local clusters of both infections were identified using the Kulldorff's scan statistic. A total of 4,751 participants above 5 years of age (median: 23 years; IQR: 11-41) were included. The overall prevalence of taeniasis was 23.4% (95% CI: 22.2-24.6), ranging from 1 to 60% between villages, with a significant between-household variance of 2.43 (SE=0.29,  $p < 0.05$ ).



## **Age-related patterns of polyparasitism with *Taenia solium*, schistosomes and soil-transmitted helminths in a co-endemic village of Democratic Republic of Congo**

Joule Madinga, Katja Polman, Kirezi Kanobana, Lisette van Lieshout Eric Brienen, Nicolas Praet, Constantin Kabwe, Sarah Gabriël, Pierre Dorny, Pascal Lutumba, Niko Speybroeck

Institute of Tropical Medicine, Antwerp; Université catholique de Louvain  
jmadinga@yahoo.fr

Helminth co-infections are common in sub-Saharan Africa. However, little is known about the distribution and determinants of co-infections with *Taenia solium* taeniasis/cysticercosis and about the consequences for control. Building on our previously published community-based study on human cysticercosis in Malanga village (n=943) in Democratic Republic of Congo, a subsample of 330 participants was analyzed to assess patterns of single and co-infections with schistosomes, soil-transmitted helminths (STH) and the complex *Taenia solium* taeniasis/cysticercosis. Demographic data, stool, urine and blood samples collected from each participant were used for the present study. Real time PCR assays were used to detect STH, *T. solium* and *Schistosoma* DNA in stool samples and *Schistosoma* DNA in urine samples. Sera were tested using the B158/B60 monoclonal antibody-based antigen ELISA and enzyme-linked immunoelectrotransfer blot assay for cysticercosis. Prevalences of helminth (co-)infections were stratified by age categories. Chi-square or Fisher's exact tests and logistic regressions were applied to assess associations between helminth species. A change point analysis was applied to assess significant shifts in the proportion of helminth (co-)infection by age. On 330 participants included, 72.7% were infected with at least one helminth species; 33% harbored single helminth species and 39.7% harbored at least two helminth species. All age categories and village districts were affected. Significant pair-wise associations were found between parasite species; e.g between STH species, between *N. americanus*, *S. stercoralis* and *T. solium* cysticerci.

## **Epidemiological study in *T. solium* and *T. saginata* larvae infestation in pigs and cattle from Romania**

Ana-Maria Oleleu<sup>1</sup>, Calin Gherman<sup>1</sup>, Anamaria Cozma<sup>3</sup>, Ioan Oleleu<sup>1</sup>, Vasile Cozma<sup>1,2</sup>

<sup>1</sup> University of Agricultural Sciences and Veterinary Medicine Cluj-Napoca, Romania

<sup>2</sup> Academy of Agricultural and Forestry Sciences Bucharest, Romania

<sup>3</sup> University of Medicine and Pharmacy “Iuliu Hațieganu” Cluj-Napoca, Romania  
cozmavasile@yahoo.com

Muscular cysticercosis caused by *T. solium* (swine) and *T. saginata* (cattle) larvae is a zoonosis of public health importance. A retrospective epidemiological study was performed during the period 2009-2013, by assessing report/surveillance systems and the management of infected animals, by analyzing the temporal and spatial distribution of muscular cysticercosis in Romania. In terms of spatial spread, outbreaks in porcine cysticercosis were discovered in 7 counties (16.66%) of the 42 existing in Romania; the prevalence of positive cases, nationwide, can be characterized as low infestation, with an average value of 0.45%. During the studied period, there were a total of 10 disease outbreaks. In terms of temporal spread, cases of disease had been recorded every year. In the same period, a total of 471 cases with suspected muscle cysticercosis have been reported in cattle, with a total of 13 cases confirmed. In terms of spatial spread, outbreaks were found in three counties (7.14%) of the 42. The data obtained allow us to observe trends of evolution in *T. saginata* larvae infestation in the northern region of Romania, where 12 cases were detected out of 13. In terms of temporal spread, it was found that cases of animals diagnosed with bovine cysticercosis were reported in two years out of five, in 2009 and 2010, respectively. In Romania, the introduction of serological surveillance and molecular diagnostic is required. This paper was published under the frame of European Social Fund, Human Resources Development Operational Programme 2007-2013, project no. POSDRU/159/1.5/136893.

## Epidemiology, impact and control of bovine cysticercosis in Europe: a systematic review

Minerva Laranjo-González<sup>1</sup>, Brecht Devleeschauwer<sup>2</sup>, Sarah Gabriël<sup>3</sup>, Pierre Dorny<sup>3,4</sup>, Alberto Allepuz<sup>1,5</sup>

<sup>1</sup> Centre de Recerca en Sanitat Animal (CRESA)-Institut de Recerca i Tecnologia Agroalimentàries (IRTA), Campus UAB, 08193 Bellaterra, Barcelona, Spain

<sup>2</sup> Department of Animal Sciences and Emerging Pathogens Institute, University of Florida, Gainesville, FL, USA

<sup>3</sup> Department of Virology, Parasitology and Immunology, Faculty of Veterinary Medicine, Merelbeke, Ghent University, Belgium

<sup>4</sup> Department of Biomedical Sciences, Institute of Tropical Medicine, Antwerp, Belgium

<sup>5</sup> Departament de Sanitat i Anatomia Animals, Universitat Autònoma de Barcelona, 08193 Bellaterra, Barcelona, Spain

minervalg@hotmail.com

**Introduction and Objectives:** Bovine cysticercosis in Europe has been known for centuries but the data showing the occurrence of this zoonosis are scarce. The aim of this paper is to review and present the current knowledge of bovine cysticercosis in Europe.

**Methods:** We conducted a systematic review of studies published in three international databases between 1990 and November 2014 by following a predefined search strategy. Studies were selected by applying predefined exclusion criteria. Qualitative and quantitative data on prevalence, risk factors, burden and interventions were extracted.

**Results:** Reports on prevalence were available for around half of the countries, mostly from western and central Europe and for a few of them only data from before 1990 were available. Prevalence based on meat inspection was generally low (in 95% of the records it was below 6.2%) and varied between and within countries. Serology and detailed meat inspection provided higher prevalence (i.e. 0.41%-14%). Few studies analysing risk factors were identified and reported factors related to access to pastures and to risky waters, dairy production and uncontrolled human defecation in the proximity of the farm among others. Only one estimate, for only one country, of the economic impact of the disease could be identified). Recommended interventions were focused on increasing diagnostic test sensitivity or the application of risk based surveillance strategies.

**Conclusions:** There is a lack of complete and updated data on most countries, especially in eastern Europe. Further risk factor studies might be needed especially in eastern Europe, together with estimates about the current burden of the disease in all European countries.

## **Sensitivity of partial carcass dissection for assessment of porcine cysticercosis at necropsy**

M.W. Lightowlers<sup>1</sup>, E. Assana<sup>2</sup>, C. Jayashi<sup>3</sup>, C.G. Gauci<sup>1</sup>, M. Donadeu<sup>1</sup>

<sup>1</sup>The University of Melbourne, Faculty of Veterinary and Agricultural Sciences, Veterinary Clinical Centre, 250 Princes Highway, Werribee, Victoria 3030, Australia

<sup>2</sup>The University of Ngaoundere, School of Veterinary Medicine and Sciences, P.O. Box 454, Ngaoundere, Cameroon

<sup>3</sup>The University of Queensland, AIBN, Building 75, Cnr College Road & Old Cooper Road, Brisbane QLD 4072, Australia  
marshall@unimelb.edu.au

Many interventions against *Taenia solium* are evaluated by assessing changes in the prevalence of porcine cysticercosis ascertained by carcass dissection. Financial and logistical difficulties often prohibit dissection of entire pig carcasses. We assessed 209 pigs from rural areas of Cameroon and Peru for the presence of *T. solium* cysticerci and determined the distribution of parasites within the musculature of infected animals. Considering the presence of cysts in the tongue, masticatory muscles and heart, 31 of the 38 (81%) naturally infected animals were identified as having cysts. Dissection of only the tongue, masticatory muscles and heart provides a relatively sensitive and highly specific method for diagnosis of porcine cysticercosis.

## **Molecular diagnosis of Taeniasis/Cysticercosis complex: Analytical sensitivity of real time PCR based on HDP2 and Ptsol9 repetitive sequences**

Maria Flores-Chavez, Cristina Domínguez-Hidalgo, Yamileth Monje, Gabriela Molini,  
Selene Martinez, Teresa Garate

Parasitology Department, National Microbiology Centre, Instituto de Salud Carlos III,  
Spain  
mflores@isciii.es

**Introduction:** In Spain, taeniasis by *T. saginata* is an autochthonous and imported infection, whereas taeniasis/cysticercosis by *T. solium* is mainly associated with travel and immigration. In diagnosis, the eggs identification allows detection of *Taenia* tapeworm carriers, and proglottid morphological analysis permits taeniid species-specific determination. If feces samples contain mainly eggs or proglottid pieces, PCR is a good alternative to ascertain between *T. solium* and *T. saginata*. Therefore, we compare the limit of detection (LOD) of two real time PCR based on repetitive DNA sequences known as HDP2 and pTsol9.

**Material and Methods:** DNA from cerebrospinal fluid, tissue biopsies, proglottids and stool samples, obtained from patients attended in Spanish hospitals were analyzed. pTsol9-PCR was performed in a single run, whereas HDP2-PCR was carried out in seminested-PCR. Temperature of melting ( $T_m$ ) analysis was used to distinguish species.

**Results:** The HDP2-seminested-PCR had an LOD of 100 fg for both *T. solium* and *T. saginata*; although in feces samples, this LOD was 10 fold lower for *T. solium*. In contrast, pTsol9-PCR showed an LOD of 10 fg for *T. solium*. From August 2012 to September 2015, we confirmed 9 neurocysticercosis and 15 taeniasis cases (one by *T. solium*).

**Conclusion:** Real-time PCR protocols presented similar LODs regarding conventional PCR. pTsol9 showed excellent sensitivity to detect *T. solium*, whereas HDP2-PCR was able to distinguish between *T. solium* and *T. saginata* by  $T_m$  analysis. In the copro-DNA diagnosis, the seminested-PCR was the best protocol to increase the LOD and distinguish between species.

## Improving LAMP assays for molecular detection of *Taenia* species

Megido L<sup>1</sup>, Gárate T<sup>2</sup>, Muro A<sup>1</sup>, Flores-Chavez M<sup>2</sup>, Perteguer MJ<sup>2</sup>, López-Abán J<sup>1</sup>,  
Fernández-Soto P<sup>1</sup>

<sup>1</sup> CIETUS, Salamanca, Spain

<sup>2</sup> Parasitología, Centro Nacional de Microbiología, ISCIII, Majadahonda, Madrid, Spain  
tgarate@isciii.es

**Introduction:** New molecular tools are desired to solve the problems of microscopy diagnosis of *Taenia* species. At present there is a Loop-mediated isothermal amplification (LAMP) assay described to identify *Taenia saginata*, *T. solium* and *T. asiatica*. For *T. hydatigena* no LAMP assay is yet developed.

**Objectives:** To evaluate, improve, and standardize the LAMP assays described for detection of *Taenia* species, and to design a new LAMP assay for *T. hydatigena*.

**Materials And Methods:** We evaluated the conditions described for amplification of *Taenia* species by LAMP assay. For all our trials gDNA from the taeniid species was used. To establish the standard protocol for our in house *Taenia*-LAMP, we used different polymerases and reaction mixtures. A first step in primers design for *T. hydatigena* diagnosis was based on literature searches to identify potential DNA sequences. GeneBank sequences initially considered were tested in silico through BLAST searches and alignment analysis.

**Results:** The best results for the three *Taenia* species were obtained by using Bst 2.0 DNA polymerase, Isothermal Amplification Buffer, 0.8M betaine, 0.8mM MgSO<sub>4</sub>. All positive results could be visually observed by both inspecting color change and on agarose gels. For *T. hydatigena* several potentially specific sequences have been identified.

**Conclusions:** LAMP assays previously described for *Taenia* species have been improved to be used easily in future routine analysis. For *T. hydatigena* potentially specific sequences have been established. ACKNOWLEDGEMENTS: We thank Doctors Gabriel and Dorny for providing taeniids' gDNAs, CYSTINET and RICET (RD12/0018).

## **CystiSim – an agent-based model for *Taenia solium* transmission and control**

Uffe Christian Braae<sup>1</sup>, Brecht Devleesschauwer<sup>2,3</sup>, Sarah Gabriël<sup>4</sup>, Pierre Dorny<sup>2,4</sup>, Niko Speybroeck<sup>5</sup>, Pascal Magnussen<sup>1</sup>, Maria Vang Johansen<sup>1</sup>

<sup>1</sup> University of Copenhagen, Denmark

<sup>2</sup> Ghent University, Belgium

<sup>3</sup> University of Florida, USA

<sup>4</sup> Institute of Tropical Medicine, Belgium

<sup>5</sup> Université catholique de Louvain, Belgium

braae@sund.ku.dk

*Taenia solium* taeniosis/cysticercosis was declared eradicable by the International Task Force for Disease Eradication in 1993, but remains a neglected zoonosis due to limited information about its transmission and validation of intervention tools. To address this gap, we developed cystiSim, an agent-based model for *T. solium* transmission and control. The model was developed in R and is publicly available as an R package (<https://github.com/brechtdv/cystiSim/>). The model description adheres to the Overview, Design concepts, and Details (ODD) protocol. The model consists of two entities: pigs and humans. Pigs acquire cysticercosis through the environment or by direct contact with a tapeworm carrier's faeces, leading to light or high infection intensities, respectively. Humans acquire taeniosis from slaughtered pigs proportional to their infection intensity. The model allows evaluation of three interventions measures or combinations hereof: human mass drug administration (MDA), pig MDA, and pig vaccination. From the modelled simulations, cystiSim suggests that the combination of pig MDA and vaccination may have promising results. However, pig MDA as a standalone tool also provides a significant effect in reduction of *T. solium* prevalence. Human MDA is the least effective intervention measure. In comparison with an existing mathematical model for *T. solium* transmission, cystiSim also includes parasite maturation, host immunity, and environmental contamination. Adding these key biological parameters to the model resulted in new insights in the potential effect of intervention measures.

## **Effect of repeated mass drug administration with praziquantel and track and treat of taeniosis cases on the prevalence of taeniosis in *Taenia solium* endemic rural communities of Tanzania**

Uffe Christian Braae<sup>1</sup>, Pascal Magnussen<sup>1</sup>, Benedict Ndawi<sup>2</sup>, Wendy Harrison<sup>3</sup>, Faustin Lekule<sup>4</sup>, Maria Vang Johansen<sup>1</sup>

<sup>1</sup> University of Copenhagen, Denmark

<sup>2</sup> Bora Professional Consultancy Services, Iringa, Tanzania

<sup>3</sup> Imperial College London, United Kingdom

<sup>4</sup> Sokoine University of Agriculture, Tanzania

braae@sund.ku.dk

This study evaluated the effect of mass drug administration (MDA) with praziquantel administered to school-aged children (SAC) combined with ‘track and treat’ of taeniosis cases on the prevalence of taeniosis. The study was conducted in 14 villages in Mbozi and Mbeya district, Tanzania. SAC received MDA with praziquantel in 2012 (both districts) and in 2013 (Mbozi only). Three cross-sectional population-based surveys were performed in 2012 (R0), 2013 (R1), and 2014 (R2). In each survey approximately 3,000 participants of all ages were tested using copro-antigen-ELISA. The prevalence of taeniosis was significantly higher ( $p=0.007$ ) in Mbozi (3.0%) at R0 compared to Mbeya (1.5%). Twelve months after MDA in both districts (R1), the prevalence had dropped significantly in both Mbozi (2.0%,  $p=0.024$ ) and in Mbeya (0.3%,  $p=0.004$ ), but the significant difference between the districts persisted ( $p<0.001$ ). Ten months after the second round of MDA in Mbozi (R2), the prevalence had dropped significantly again in Mbozi (0.8%,  $p<0.001$ ), but had slightly increased in Mbeya (0.5%,  $p=0.051$ ), with no difference between the two ( $p=0.51$ ). Among SAC in Mbozi, infection significantly decreased at R1 ( $p=0.004$ , OR 0.12 CI: 0.02-0.41) and R2 ( $p=0.001$ , OR 0.24, CI: 0.09-0.53) when comparing to R0. In Mbeya infection decreased at R1 ( $p=0.013$ , OR 0.14, CI: 0.02-0.55), but no difference was found for R2 ( $p=0.089$ ), compared to R0 among SAC. This study showed that school-based MDA with praziquantel in combination with ‘track and treat’ of taeniosis cases reduced the prevalence of taeniosis, and that annual MDA was better than biennially MDA.



## Starting new strategies of investigation on cysticercosis: systematic review of Taeniasis/cysticercosis and perspectives in Cote d'Ivoire

Offianan AT<sup>1</sup>, Koffi E<sup>2</sup>, Boka OM<sup>3</sup>, Cisse D<sup>3</sup>, Meite A<sup>4</sup>, Angora KE<sup>1</sup>, Soumahoro MK<sup>5</sup>, Assi B<sup>6</sup>, Djaman J<sup>7</sup>, Jambou R<sup>1</sup>

<sup>1</sup> Département Parasitologie Mycologie, Institut Pasteur de Côte d'Ivoire

<sup>2</sup> Département Environnement et Santé, Institut Pasteur de Côte d'Ivoire

<sup>3</sup> Direction Services Vétérinaires, Ministère des ressources animales et halieutiques

<sup>4</sup> Programme National de Lutte contre les schistosomiasés, les Geohelminthiasés et la Filariose Lymphatique, Ministère de la Santé et de la Lutte contre le Sida

<sup>5</sup> Département Epidémiologie Recherche Clinique, Institut Pasteur de Côte d'Ivoire

<sup>6</sup> Service de neurologie, CHU Cocody Abidjan, Côte d'Ivoire

<sup>7</sup> Département Biochimie clinique et Fondamentale Institut Pasteur de Côte d'Ivoire

rjambou@pasteur.fr; rjambou@pasteur.ci

The objective of this study was to collect data to draw an action plan for the evaluation and the control of cysticercosis in Ivory Coast. However, due to funds shortage a national study was not possible, so areas of interest for the first field studies must be targetted. Very few data were published and usual diagnostic tools like CT-Scan and serology are poorly available for patients. We conducted a systematic review of cases of Taeniasis/ cysticercosis reported in grey literature to plan preliminary field studies. Systematic review of the literature was conducted using search engines: PubMed, British Library, ScienceDirect, African Journals Online and GoogleScholar using the search terms: *Taenia solium*, cysticercosis, Taeniasis, neurocysticercosis, neglected tropical diseases, helminths, control, efficiency etc. Grey literature has been collected: theses and masters documents, administrative reports from universities, research institutes and veterinary services. Pharmacy (12) and medicine (4) thesis works and the annual reports of the Department of Parasitology Mycology at the Institute Pasteur of Côte d'Ivoire (1990-2010) reported varying prevalence of *Taenia* sp. from 0.3% to 11.1%, with higher rates at Toumodi (11.1%), Divo and Lakota (5.4%) and Abidjan (2.5%). Four publications reported cases of human cysticercosis, the most recent one (two cases of neurocysticercosis determined by CT scan) in 1999, with. Two veterinary theses conducted in 1978 and one in 1991 show a prevalence of porcine cysticercosis at 2.5%, with higher prevalence at Korhogo (3.9%) and Bouaké (5, 7%). These data were used to design field studies currently in process. Strategy of control will be discussed.

## Characterizing human cysticercosis in Portugal 2006-2013

Vilhena M<sup>1</sup>, Fonseca AG<sup>2</sup>, Marques da Silva JR<sup>4</sup>, Dias SS<sup>3</sup>, Torgal J<sup>2</sup>

<sup>1</sup> ICAAM, Évora U. Évora, Portugal

<sup>2</sup> Public Health Department, Faculdade Ciências Médicas (NOVA Medical School), Universidade Nova de Lisboa (Nova Lisbon University), Lisboa, Portugal

<sup>3</sup> UIS-ESSLei-IPLeiria, Leiria, Portugal; Public Health Department, Faculdade Ciências Médicas (NOVA Medical School), Universidade Nova de Lisboa (Nova Lisbon University)

<sup>4</sup> ICAAM, CITI, DREAMS, Rural Engineering Department, Évora U. Évora, Portugal  
mmcv@uevora.pt

Cysticercosis results from the ingestion *Taenia solium* eggs directly by faecal-oral route or contaminated food or water. While, still considered a leading cause of acquired epilepsy in developed countries, this zoonosis has been controlled or eradicated in industrialized countries due to significant improvements in sanitation, pig rearing and slaughterhouse control systems. We developed a retrospective study on human neurocysticercosis (NCC) hospitalisations based on the national database resulting from National Health Service (NHS) hospital episodes except those of Madeira and Azores Islands. Between 2006 and 2013 there were 357 hospitalized NCC cases in Portugal. Annual frequency of cases between 2006-2013 kept stable (mean 45). NCC was most frequent in those aged 25-34 years (59; 16,5%) and those >75 years (65; 18,2%). Overall, mean age was 47,3 years (median age 45, standard deviation 41,1, mode 28) and 176 cases were in males (49,3%); no significant differences were observed between age and gender (t-student, p>0,05). In Norte Region cases tended to be older than in Lisboa and Vale do Tejo Region. The Directorate-General of Health established the National Observatory of Cysticercosis and Teniasis which will define criteria for NCC cases monitoring and surveillance (hospitalized and non-hospitalized cases).

## Treatment of neurocysticercosis in Serbia

Olga Dulović<sup>1,2</sup>, Jasmina Poluga<sup>1,2</sup>, Ivana Gmizić<sup>1</sup>, Zorica Dakić<sup>1</sup>, Branko Bobić<sup>3</sup>,  
Olgica Djurković-Djaković<sup>3</sup>

<sup>1</sup> Clinic for Infectious and Tropical Diseases, Clinical Center of Serbia, Belgrade, Serbia

<sup>2</sup> Medical Faculty, University of Belgrade, Serbia

<sup>3</sup> Centre of excellence for Food- and Vector-borne Zoonoses, Institute for Medical Research, University of Belgrade, Serbia  
olgadulovic@gmail.com

**Introduction:** Antiparasitic therapy for neurocysticercosis (NCC) has been available for 35 years, but treatment is still burdened with controversies on whether and when to treat, the choice of drug / drug combination, length of treatment etc. We here report the clinical outcome in a series of NCC patients treated with antiparasitic drugs.

**Patients:** A total of 29 patients were diagnosed with NCC at the Clinic for Infectious Diseases in Belgrade after 2001. The diagnosis was based on CT, serological and PH findings. Patients were treated with courses of Praziquantel (PZQ) 50mg/kg, Albendazol (ALB) 15mg/kg or PZQ 50mg/kg followed by ALB 15mg/kg during 15 days, repeated from one to five times during 6 months. The follow-up period lasted 6-12 months, when control CT was performed.

**Results:** Of the 25 pts treated for NCC, 4 pts received PZQ, 16 received ALB, while 5 pts received PZQ+ALB. The outcome included complete cyst resolution in 12 pts (48%), reduction in cyst number in 6 pts (24%), and unchanged CT in one, while 6 pts were lost for follow up. Although no statistical differences were shown between the treatment groups and outcome, obviously due to small group sizes, complete resolution of cysts was followed by complete resolution of symptoms including epilepsy.

**Conclusion:** Treatment of NCC patients with antiparasitic drugs, preferably ALB, may provide complete cure in about one half of the patients. However, patients with incomplete or no therapeutic response upon repeated treatment remain a problem. The best treatment approach and modalities should be carefully analyzed in each country.

## Human cysticercosis in Serbia - a 25 year national study

Branko Bobić<sup>1</sup>, Zorica Dakić<sup>2</sup>, Ivana Klun<sup>1</sup>, Aleksandra Nikolić<sup>1</sup>, Olga Dulović<sup>3,4</sup>, Vesna Turkulov<sup>5,6</sup>, Olgica Djurković-Djaković<sup>1</sup>

<sup>1</sup> Centre of excellence for Food- and Vector-borne Zoonoses, Institute for Medical Research, University of Belgrade, Serbia

<sup>2</sup> Laboratory for Parasitology, Department of Microbiology, Clinical Center of Serbia, Belgrade

<sup>3</sup> Clinic for Infectious and Tropical Diseases, Clinical Center of Serbia, Belgrade

<sup>4</sup> Medical faculty, University of Belgrade, Serbia

<sup>5</sup> Clinic for Infectious Diseases, Clinical Center of Vojvodina Novi Sad

<sup>6</sup> Medical faculty, University of Novi Sad Serbia

bobicb@imi.bg.ac.rs

**Introduction:** Serbia, like the rest of South-East Europe, is traditionally an area of sporadic autochthonous cases of *Taenia solium* infection. Human cysticercosis is not mandatory reportable and the prevalence is unknown.

**Material and methods:** To assess the frequency of cysticercosis between 1990 and 2014, an email questionnaire was sent to all hospital departments for infectious disease in Serbia. Additionally, a literature search (published between 1990 and 2014) was conducted to detect cases not reported in the email interview.

**Results:** A total of 168 cases of neurocysticercosis and one case of kidney cysticercosis were recorded. Yearly incidence during the study period ranged from 0-0.29 reported cases / 100,000 inhabitants. During the nineties, there was a continuous increase in the number of reported cases ( $\chi^2=14,500$ ,  $p=0.00014$ ), while after 2000 a decrease was noted ( $\chi^2=13.393$ ,  $p=0.00025$ ). Preceding taeniosis was reported in 3.2% of patients. Only 8.8% of patients were professionally exposed (10 farmers and one forest worker). There was no information regarding visits to endemic areas. Infection was most frequent in western Serbia along the Sava and Drina rivers. The majority of hospitalized patients (67.2%) were aged 30-59, while only 6 were under the age of 20 (mean age  $46.2 \pm 1.1$ ). Gender distribution was similar (females 48.7%, males 51.3%;  $\chi^2=0.031$ ,  $p=0.859$ ).

**Discussion:** Although there is a lack of comprehensive high quality epidemiological data on cysticercosis in Serbia, the presented results let us conclude that infection with *Taenia solium* does not seem to be re-emerging, but that it is continuously present.

## **Cognitive impairment and quality of life of people with epilepsy and neurocysticercosis in Zambia**

Anne L. Nau<sup>1\*</sup>, Kabemba E. Mwape<sup>2\*</sup>, Jasmin Wiefek<sup>3</sup>, Kathie Schmidt<sup>4</sup>, Emmanuel N. Abatih<sup>5</sup>, Pierre Dorny<sup>5</sup>, Nicolas Praet<sup>5</sup>, Clarence Chiluba<sup>6</sup>, Holger Schmidt<sup>7</sup>, Isaac K. Phiri<sup>2</sup>, Andrea S. Winkler<sup>8</sup>, Sarah Gabriël<sup>5\*</sup>, Joachim Blocher<sup>9,10\*</sup> (\*these authors contributed equally)

<sup>1</sup> Rehabilitation Day Clinic Pankow, Berlin, Germany

<sup>2</sup> Department of Clinical Studies, School of Veterinary Medicine, University of Zambia, Lusaka, Zambia

<sup>3</sup> Europe-University of Flensburg, Flensburg, Germany

<sup>4</sup> Department of Neuroradiology, Medical University Center Göttingen, Göttingen, Germany

<sup>5</sup> Department of Biomedical Sciences, Institute of Tropical Medicine, Antwerp, Belgium

<sup>6</sup> Levy Mwanawasa General Hospital, Lusaka, Zambia

<sup>7</sup> Department of Neurology, Elbe-Kliniken Stade/Buxtehude GmbH, Stade, Germany

<sup>8</sup> Department of Neurology, Technical University Munich, Munich, Germany

<sup>9</sup> Department of Neurology, Medical University Center Göttingen, Göttingen, Germany

<sup>10</sup> Department of Psychiatry, Regional Hospital Rankweil, Austria

anne.nau@posteo.de

Quality of life (QoL) and cognitive impairment are important to assess the burden of epilepsy and Neurocysticercosis (NCC), which are common but neglected in Sub-Saharan Africa. The aims of this study were to assess cognitive performance and QoL of people with epilepsy (PWE) in Zambia and to explore differences in PWE with and without NCC. In this community based, cross-sectional case-control-study, 47 PWE and 50 healthy controls completed five neuropsychological tests (Mini Mental State Examination, Digit Span, Selective Reminding Test, Spatial Recall Test, Testbattery of Attentional Performance), and a QoL questionnaire (WHOQOL-BREF). Comparisons were made between PWE and healthy controls and between PWE with NCC (n=28) and without NCC (n=19), respectively, using Analysis of Covariance and moderated t-tests while correcting for confounders such as age, gender, schooling years and adjusting for multiplicity. Spatial memory, orientation, speech and language reception, visuo-constructive ability, and attentional performance were significantly reduced in PWE compared to healthy controls (all  $p < 0.01$ ). There were no significant differences between these two groups regarding working memory and verbal learning. QoL of PWE was significantly lower in two domains (psychological, environment) compared to healthy controls (both  $p < 0.01$ ). There were no significant differences in neuropsychological performance and QoL between PWE with NCC and without NCC. Epilepsy was associated with cognitive impairment and partially reduced QoL. PWE due to NCC had similar impairment and QoL compared to PWE due to other causes.

## Immune response during neurocysticercosis in Madagascar: application for diagnostic

Prisca Ramandanirainy<sup>1</sup>, Anjanirina Rahantamalala<sup>1</sup>, Mahenintsoa Rakotondrazaka<sup>1</sup>, Remy Guebey<sup>1</sup>, Mathilde Boussard<sup>1</sup>, Romy Razakandrainibe<sup>1</sup>, Julien Razafimahefa<sup>2</sup>, Thierry Franchard<sup>1</sup>, Mickael Randrianarison<sup>3</sup>, Noel Zodaly<sup>2</sup>, Zara Razafiarimanga<sup>4</sup>, Ramaroson Vololoniaina<sup>4</sup>, Ronan Jambou<sup>1,5</sup>

<sup>1</sup>Immunology Unit Institut Pasteur de Madagascar, Antananarivo Madagascar

<sup>2</sup>Clinic of Neurology, Befelatanana Hospital, Antananarivo Madagascar

<sup>3</sup>Radiology Unit, CENHOSOA, Antananarivo Madagascar

<sup>4</sup>Immunology Unit, Faculty of Sciences Antananarivo

<sup>5</sup>Department of Parasite and Vector Insect., Institute Pasteur Paris , France  
rjambou@pasteur.fr; rjambou@pasteur.ci

**Background:** Neurocysticercosis (NCC) is the most important cause of seizure in tropical countries. In Madagascar seroprevalence of cysticercosis (in blood) can reach 50% in population of the highlands. In this setting biological methods used in blood can give high level of positivity without neurocysticercosis due to extra-cerebral localisation of the cysts. Serology can also be poorly sensitive when a single cyst is located in brain. In the same time CT-scan is poorly available in tropical countries and its cost is usually supported by the patients themselves, which compromises its usefulness. This leads to treatment of the patients with anti-helminths on behalf of ELISA anti-Tsolium results. We thus urgently need to improve diagnostic of NCC.

**Methodology/Principal Findings:** We analysed cellular and serological immune response in adult patients suffering from recent seizures, with or without images of NCC on CT-Scan. We used both reference glycosylated proteins and liquid of cysticercus (LC) as antigen for lymphocyte proliferation tests (LPT) and for serological analysis. In the same time we compared anti-Tsolium isotypes response (IgE, IgA, IgD, IgG) in blood and in cerebrospinal fluid (CSF). LPT using LC but not glycosylated protein was found to be an accurate method to detect cysticercosis. In the same time isotype analysis enlightened clearly local secretion of antibodies in CSF and IgD was more accurate to detect this proliferation than IgA or IgE.

**Conclusions/Significance:** Cellular immune response and its field counterpart the skin test can be a new way to analyse immune response to cysticercosis. However, when CSF examination is possible, quantitative comparison of isotypes in blood and CSF could be informative for the diagnostic of NCC.

## Severe seizures in pigs naturally infected with *Taenia solium*

Chiara Trevisan<sup>1</sup>, Ernatus M Mkupasi<sup>2</sup>, Helena Ngowi<sup>2</sup>, Björn Forkman<sup>3</sup>, Maria V Johansen<sup>1</sup>

<sup>1</sup> Department of Veterinary Disease Biology, University of Copenhagen, Denmark

<sup>2</sup> Department of Veterinary Medicine and Public Health, Sokoine University of Agriculture Tanzania

<sup>3</sup> Department of Large Animal Sciences, University of Copenhagen, Denmark

Chiara@sund.ku.dk

Neurocysticercosis (NCC) caused by *Taenia solium* is a serious neurological disease. In humans neurological symptoms have been thoroughly documented however there is limited information on clinical signs in pigs with NCC. On the contrary, among the scientific community it is believed that pigs with NCC are asymptomatic. The aim of our study was to describe clinical manifestations associated with NCC in pigs and correlate the manifestations to number and distribution of cysts in brains of these naturally infected pigs in Tanzania. Sixteen infected and 15 non-infected pigs were videotaped for 14 days using close circuit television cameras. At the end of the recording period, the pigs were slaughtered and the brains were dissected, cysts counted and their location noted. During recording period, two infected pigs were observed having seizures. Seizures occurred on random days and their durations varied largely. Some of the observed autonomic signs were chewing motions with foamy salivation and ear stiffening. Motor signs included tonic muscle contractions followed by a sudden diminution in all muscle tone leading to collapse. Stereotypic walk in circles was observed in several occasions. At dissection, both pigs had a high number of brain cysts (247 and 241 cysts). These two pigs were also older compared to the others. Results of this study have shown that pigs with NCC can develop clinical signs and suffer from seizures like humans with symptomatic NCC. Results of this study could potentially open up a new experimental pathway to explore the aetiology of neurological symptoms in humans.

## Rare case of taeniasis in the Istrian region

Lorena Lazarić Stefanović<sup>1</sup>, Jasna Valić<sup>2</sup>, Jasmina Kučinar<sup>1</sup>, Vlasta Skopljak<sup>2</sup>

Public Health Institute of the Istrian Region - Pula, Croatia

<sup>1</sup> Department of Microbiology

<sup>2</sup> Department of Epidemiology

lorenalazaricstefanovic@gmail.com

In the last 10 years (2005-2014) only 30 cases of taeniasis were reported in Croatia. We present the case of a 30-year-old man infected with tapeworm. He contacted the epidemiologist in our Institute for help in May, 2015. The patient was in good health condition without any intestinal symptom. He reported his habit to eat raw beef meat on daily basis. Since January, 2013. he noticed some white structures passed in the stool. From that period, he expelled longer pieces of tapeworm twice. Until May, 2015. he has got six time therapy with mebendazole without any result. In August, 2015 he brought two proglottides and feces sample for parasitologic examination. Parasitologic analysis detected *Taenia saginata* (beef tapeworm) and the patient was treated with niclosamide. The day after the therapy the tapeworm was passed in the stool and was examined by the microbiologist. As the scolex was not found the patient was suggested to stay in contact with the epidemiologist for a follow up and further parasitologic analysis of the stool.



## The societal cost of *Taenia solium* cysticercosis in Tanzania

Chiara Trevisan<sup>1</sup>, Brecht Devleesschauwer<sup>2</sup>, Veronika Schmidt<sup>3</sup>, Andrea Sylvia Winkler<sup>3</sup>, Wendy Harrison<sup>4</sup>, Maria Vang Johansen<sup>1</sup>

<sup>1</sup> Faculty of Health and Medical Sciences, University of Copenhagen

<sup>2</sup> Faculty of Veterinary Medicine, Ghent University

<sup>3</sup> Technische Universität München, Munich

<sup>4</sup> School of Public Health, Imperial College London, London

Chiara@sund.ku.dk

*Taenia solium* is a zoonotic parasite prevalent in many low income countries and recognised as a public health threat, however the burden it poses on human and pig populations in Tanzania is unknown. The aim of this study was to estimate the societal cost of *T. solium* cysticercosis in Tanzania, by assessing the health and economic burden. The health burden was assessed in terms of annual number of neurocysticercosis (NCC) associated epilepsy incident cases, deaths and Disability-Adjusted Life Years (DALYs), while the economic burden was assessed in terms of direct and indirect costs imposed by NCC-associated epilepsy and losses due to porcine cysticercosis. Based on our results we found *T. solium* cysticercosis to be present in 10 regions of the country and to contribute to a significant economic burden for the population. The annual number of NCC-associated epilepsy incident cases and deaths were 22,410 (95% Uncertainty Interval (UI), 5,860 - 49,272) and 324 (95% UI, 54 - 929), respectively. More than 11 percent of the pigs were infected with the parasite. The number of DALYs per thousand person-years for NCC-associated epilepsy was 0.98 (95% UI, 0.23 - 2.35). Around six million USD were spent due to NCC-associated epilepsy and nearly three million USD were lost due to porcine cysticercosis. Our results show that *T. solium* imposes a serious public health, agricultural and economic threat. We urge that a One Health approach is taken involving all relevant governmental agencies to find sustainable solutions for prevention, control and elimination of *T. solium*.

## Biosecurity on pig farms

Jovan Bojkovski

University of Belgrade, Faculty of Veterinary Medicine  
bojkovski@vet.bg.ac.rs

Planned use of biosecurity measures is crucial in protecting the health of pigs and production success. Required level of biosecurity in pig farms should be result of logical thinking and timely taken action, as well as recognition of the specific threats and weak points in the production process. The aim of our study was to evaluate certain biosecurity measures at pig farm: farm isolation, quarantine for animals, herd health status control, relation of personnel to animals and equipment, between-farms and on-farm traffic control, food safety, manure management, removal of dead animals, and other animals, birds and rodents control). The two industrial swine farms, which constitute the agricultural cooperatoons , we observed estimation settings biosecurity measures, the degree isolation, the introduction of newly acquired animals, herd health status, attitude towards equipment and assessment motion control traffic within the farm, visitors regime and security feeding and watering , remove corpses and sanitation. We used the questionnaire method for collecting data relating to realise biosecurity measures. One of the main problems is that the farm is not organised education for workers.. Efforts have been made to the schedules of workers to the technological stages of production and to organize training courses for workers. There are no built biosecurity measures that are relevant to the regime of the visit. Our recommendation is that regular control of biosecurity level should become a routine at the pig farm of industrial type.

## **Introducing a new inter-disciplinary network on *Taenia solium* cysticercosis and taeniosis research in sub-Saharan Africa CYSTINET – Africa**

Schmidt V<sup>1</sup>, Ngowi H, Ngowi B, Mfinanga S, Sikasunge CS, Phiri IK, Mwape KE, Normahomed E, Brügger B, Prazeres da Costa C, Winkler AS

<sup>1</sup> Department of Neurology, Klinikum rechts der Isar, Technical University Munich, Germany  
veronika.schmidt@tum.de

*Taenia solium* cysticercosis/taeniosis (TSCT), an emerging but neglected zoonosis, represents a potentially eradicable disease complex with huge impact on human and animal health in many countries of sub-Saharan Africa. To fill gaps on the way to control/elimination of TSCT in these countries an interdisciplinary research platform will be developed integrating basic science, epidemiological, neurological, immunological and sociocultural research activities, capacity building and international networking. So far four African partners - one in Mozambique, two in Tanzania and one in Zambia - and two German partners have been linked with an international advisory board including the WHO, CDC Atlanta, and CYSTINET-Europe. International TSCT conferences held in Africa and the development of an IT platform that comprises a virtual one-health center with a research school as well as tools for electronic case management and networking are other key elements of this upcoming platform. This new TSCT network will create impact by linking human, animal and community health workers (based on the “one-health” principle) at various levels in sub-Saharan Africa. A rapid expansion of CYSTINET-Africa and its activities is envisaged and promising new collaborations are already on the way with teams in Uganda, Zimbabwe and Madagascar. CYSTINET - Africa will officially start in spring 2016 and has received funding from the German Federal Ministry of Education and Research (BMBF) for activities planned until 2021.

## Taeniosis in Serbia: changing trend over a 35-year period

Zorica Dakić<sup>1</sup>, Miloš Korać<sup>2,3</sup>, Branko Brmbolić<sup>2,3</sup>, Nikola Mitrović<sup>2</sup>, Ivana Milošević<sup>2,3</sup>, Jovan Malinić<sup>2</sup>, Aleksandar Marković<sup>2</sup>, Snežana Jovanović<sup>1</sup>, Olgica Djurković-Djaković<sup>4</sup>

<sup>1</sup> Department of Microbiology, Clinical Center of Serbia, Belgrade, Serbia

<sup>2</sup> Clinic for Infectious and Tropical Diseases, Clinical Center of Serbia, Belgrade, Serbia

<sup>3</sup> Medical Faculty, University of Belgrade, Serbia

<sup>4</sup> Centre of excellence for Food- and Vector-borne Zoonoses, Institute for Medical Research, University of Belgrade, Serbia

zorda\_dakic@yahoo.com

**Introduction and objectives:** During the seventies, a mean 20 cases of taeniosis were detected per year at the Laboratory for Parasitology at the Clinic for Infectious and Tropical Diseases in Belgrade. We here summarize the cases of taeniosis diagnosed over a 35-year period between 1980 and 2014.

**Design and methodology:** Data were collected from laboratory protocols and medical records. Taeniosis was diagnosed by microscopic identification of gravid proglottids and/or detection of *Taenia* eggs in stool.

**Results:** During the whole 35-year period, a total of 40 cases of taeniosis were detected (0-4 cases per year). *Taenia* eggs alone were detected in 23 patients (22 in stool, one on tape), both *Taenia* eggs and proglottids in 13, while proglottids alone were detected in 3 patients. *Taenia saginata* was identified in 15 (37.5%) cases and *Taenia* spp. in 25 (62.5%) cases. There were 21 (52.5%) male and 19 (47.5%) female patients. Mean age (data available for 20 patients) was 36.6±12.6, ranging from 9 to 66 years. Most patients were Serbian Orthodox (21, 52.5%) or Muslims (from Serbia or other areas of ex-Yugoslavia) (17, 42.5%), while two were foreigners (5%). There was a clear decline in the number of cases by decade: 21 in the period 1980-1989, 12 in 1990-1999, 4 in 2000-2009, and 3 in 2010-2014. Co-infection of taeniosis and other parasitic infections was found in 7 (17.5%) patients, of which 2 cases of co-infection with *Ascaris lumbricoides*, 3 with *Entamoeba histolytica*, and one each with *Enterobius vermicularis* and *Giardia lamblia*.

**Conclusion:** The presented data indicate a continuous declining trend of taeniosis in Serbia.

## **Slaughterhouse surveillance of bovine and porcine cysticercosis in Catalonia (2008-2014) through SESC: the slaughterhouse support network**

E. Vidal<sup>1</sup>, M. Laranjo-González<sup>1</sup>, E. Tolosa<sup>2</sup>, A. Allepuz<sup>1</sup>, A. Marco<sup>3</sup>, L.L. Picart<sup>2</sup>, M. Domingo<sup>1,3</sup>

<sup>1</sup> IRTA, Centre de Recerca en Sanitat Animal (CReSA, IRTA-UAB), Campus de la Universitat Autònoma de Barcelona, 08193 Bellaterra, Catalonia, Spain

<sup>2</sup> Agència de Salut Pública de Catalunya, Departament de Salut pública, Generalitat de Catalunya, Barcelona, Catalonia, Spain

<sup>3</sup> Departament de Sanitat i Anatomia Animals, Universitat Autònoma de Barcelona (UAB), 08193 Bellaterra, Barcelona, Catalonia, Spain  
enric.vidal@irta.cat; minerva.laranjo@irta.cat

SESC is a web-based application through which meat inspectors can submit diagnostic queries: either telematic (images and text) or including samples for laboratory diagnosis. The queries are evaluated by pathologists and other animal health experts and a report is sent back to the inspector with a final diagnosis or a list of differentials. The platform is funded by the Catalan Public Health Agency (Public Health Department of the Catalan Government, Generalitat de Catalunya) and covers the region of Catalonia (north east of Spain). It is a diagnostic support platform for meat inspectors to provide them with continuing education but it also serves as an epidemiological sentinel for the emergence of zoonosis and other relevant animal health threats. From 2008 to 2014 a total of 1074 enquiries have been managed through SESC. A significant proportion of which were aimed at the diagnosis of zoonoses such as bovine cysticercosis: 17% (119/1074), representing a 33.1% of the cattle enquiries (119/598). Of these cases an average of 60% of the queries were confirmed each year as bovine cysticercosis by histopathological examination. Even though *C. cellulosae* has not been diagnosed in pigs for years in Catalonia, 26 queries were submitted as porcine cysticercosis cases. The majority were diagnosed as *C. tenuicollis* (14/26) or epithelial cysts (10/26) and only two were muscular granulomas compatible with a parasitic ethiology. PCR failed to detect *C. cellulosae* genome. In this poster a summary and analysis of the data regarding queries related to both bovine and porcine cysticercosis in the 2008-2014 period are presented.

## Taeniosis diagnosed during last 15 years in National Centre for Epidemiology, Budapest, Hungary

István Kucsera, József Danka, Erika Orosz

National Center for Epidemiology, Department of Parasitology, Budapest, Hungary  
kucsera.istvan@oek.antsz.hu; ikucsera@gmail.com

**Introduction:** Taeniosis caused by *Taenia solium* or *Taenia saginata* is for a long time known disease in Hungary. First documented data about incidence of taeniosis in Hungary originate from Prof. Ferenc Lőrincz in 1930. Survey of 1567 person's fecal samples obtained from 8 institutions in different cities were examined from 1938-1939. In 1 person was diagnosed *T. solium* and in 2 *T. saginata*. The second communication from the same author reported about examination of 5000 diagnostic stool samples from 1928-1934 and only 5 *Taenia* sp. were detected.

**Material, methods, results:** In NCE diagnostic stool and defecated worm suspected samples of 12712 person were examined from 2000-2014. *T. saginata* was diagnosed in 16 (0,012%), *Taenia* sp. in 6 (0,005%) person. Together with County and Regional Parasitological laboratories in diagnostic stool/defecated worm-suspected samples of 328 572 person *T. saginata* was diagnosed in 20 (0,006%) and *Taenia* sp. in 19 (0,0057%). *T. solium* was not diagnosed in neither of samples. In 383 serum and 70 CSL of 346 person 519 serological examination have been performed (R-Biopharm,EIA,IgG, Novatec,EIA,IgG, Ldbio,WB,IgG). From 281 person we have got only serum, from 5 only CSL, from 60 person both serum/CSL. In serum 434 (294 EIA, 140 WB) and in CSL 85 (42 EAI, 43 WB) examination have been done. Serum of 32 person showed at least positive or borderline result. In 13 of them WB confirmatory test was negative, in 17 confirmation by WB was not performed, therefore the false results could not be excluded.

**Conclusion:** Taeniosis, particularly *T. solium*/cysticercosis nowadays is rather rare in Hungary.

## **Molecular identification of zoonotic tissue-invasive tapeworm larvae other than *Taenia solium* in suspected human cysticercosis cases**

Dennis Tappe<sup>1</sup>, Jörg Berkholtz<sup>2</sup>, Uwe Mahlke<sup>2</sup>, Hartmut Lobeck<sup>2</sup>, Thomas Nagel<sup>3</sup>, Alexandra Haeupler<sup>1</sup>, Birgit Muntau<sup>1</sup>, Paul Racz<sup>1</sup>, Sven Poppert<sup>1,4</sup>

<sup>1</sup> Bernhard Nocht Institute for Tropical Medicine, Hamburg, Germany

<sup>2</sup> Ernst von Bergmann Klinikum, Potsdam, Germany

<sup>3</sup> Praxis für Pathologie Wangen, Wangen, Germany

<sup>4</sup> University Medical Center, Hamburg-Eppendorf, Germany

sven@poppert.eu

Rarely zoonotic *Taenia* species other than *Taenia solium* cause human cysticercosis. The larval stages are morphologically often indistinguishable. We therefore investigated 12 samples of suspected human cysticercosis cases molecularly and surprisingly identified one *Taenia crassiceps* and one *Taenia serialis* (coenurosis) infection, caused by tapeworm larvae normally infecting rodents and sheep via eggs released from foxes and dogs.

## Outbreak of bovine cysticercosis on a cattle farm in Slovenia in 2015 - a case report

Aleksandra Vergles-Rataj<sup>1</sup>, Brane Krt<sup>1</sup>, Jože Starič<sup>1</sup>, Jožica Ježek<sup>1</sup>, Pierre Dorny<sup>2</sup>, Sarah Gabriël<sup>2</sup>, Barbara Šoba<sup>3</sup>

<sup>1</sup> Veterinary faculty, University of Ljubljana, Slovenia

<sup>2</sup> Institute of Tropical Medicine, Antwerp, Belgium

<sup>3</sup> Faculty of Medicine, University of Ljubljana, Slovenia

barbara.soba@mf.uni-lj.si

In Slovenia, bovine cysticercosis is rare. Based on routine post-mortem inspection of cattle slaughtered in approved slaughterhouses between 2007 and 2013, the annual prevalence of the disease ranges from 0.003 to 0.05 %. In 2015, an increased number of cysticercosis cases were detected by routine inspection of slaughtered bovines from a farm in a north-eastern part of Slovenia with more than 200 fattening bulls. A total of 12 carcasses showed lesions suggestive of cysticercosis, and 7 were confirmed using microscopic examination of cysts (1 case) or histopathological observation (6 cases) of muscles or heart tissues. Interestingly, 7 of the 12 suspected carcasses were positive for protozoon *Sarcocystis* sp. using histopathological observation, 4 of which were positive for cysticercosis as well. To estimate the situation among the cattle on the farm, serum samples from 63 animals were tested by the B158/B60 monoclonal antibody based antigen detecting ELISA. Circulating antigen was detected in 30.2 % (19) of the animals. Stool samples from family members of the farm were collected for microscopic examination for *Taenia* sp. ova, copro-antigen ELISA and copro PCR for *Taenia saginata* taeniasis. Altogether, 14 faecal samples from 5 family members were examined. Given that all of the samples tested negative, the family was probably not the source of animal infection. The occurrence of bovine cysticercosis on the farm caused significant economic loss. Possible sources of the infection will be discussed.



## **Cysticercosis at the slaughterhouses of the Braničevo district, Serbia**

Milena Živojinović<sup>1</sup>, Slavonka Stokić Nikolić<sup>1</sup>, D. Rogožarski<sup>1</sup>, Milica Lazić<sup>1</sup>, I. Dobrosavljević<sup>1</sup>, Gorica Rajković<sup>2</sup>, Sonja Paunović<sup>2</sup>

<sup>1</sup> Veterinary Institute Požarevac, Dunavska 89, Požarevac, Serbia

<sup>2</sup> Ministry of Agriculture and Environment, Veterinary Inspection at Braničevo district  
povetinst\_milenaz@hotmail.com

Serbia is traditionally an endemic area for *Taenia saginata* infections, a public health, veterinary and agricultural problem. According to Serbian legislation, bovine cysticercosis is a notifiable disease, with mandatory inspection of jaw muscles, tongue, heart, oesophagus, diaphragm (in case of more intense infections even thigh and shoulder muscles) at the slaughterline. From 2006 until September 2015, during routine meat inspection, veterinary inspectors reported the presence of bovine cysticercosis in five of the seven slaughterhouses of the Braničevo district. During this period, 13 bovines with cysticerci in the masseter muscles were found. Only one animal was below 12 months of age. Nine bovines were from the Braničevo district (municipalities of Veliko Gradište, Petrovac, Požarevac, Malo Crniće, Žabari) while four originated from other districts in Serbia. No further laboratory examination had been conducted. The presented results indicate a low but continuous presence of bovine cysticercosis in Serbia. These data call for further actions, which should focus on promoting meat inspection and mandatory notification of findings on the one hand, and on the other include investigations of identified local foci of cysticercosis, exchange of information with the epidemiological service, as well as better understanding of the risk associated with animal husbandry and human behavioral practices.



