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CASE STUDY OF BSE IN ANIMALS BORN AFTER THE FEED BAN (BAB) IN SWITZERLAND

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En 1990 le réseau d'épidémiosurveillance de l'encéphalopathie spongiforme bovine (ESB) était mis en place en Suisse et intégrait les vétérinaires praticiens, 2 laboratoires autorisés pour le diagnostic de l'ESB, et les Offices Fédéral et Cantonaux Vétérinaires. Au 21 Mars 1997, 246 cas d'ESB ont été diagnostiqués à partir de 604 cas suspectés. La courbe épidémique est passée par un maximum en 1995 et a commencé une décroissance sensible, notamment suite à la mise en application d'une interdiction d'affourager les ruminants avec des aliments contenant des farines de viande et d'os décidée en Décembre 1990. Toutefois, 21 cas d'ESB nés après cette interdiction (BAB) sont apparus. Une étude de cas approfondie a été mise en oeuvre afin d'en déterminer la ou les causes probables, notamment les facteurs de contamination par voie de transmission verticale, iatrogénique, ou horizontale, ou par l'alimentation. Les résultats ont montré que la majorité des élevages avaient affouragé leurs bovins avec des concentrés pour bovin, avaient aussi des porcins ou des volailles et avaient au moins un chat. Malgré le faible nombre de cas observés, il semblerait que la distribution géographique des BAB soit différente de celle d'autres cas d'ESB (nés avant l'interdiction), et que les BAB soient présents plus spécialement dans certaines zones d'élevage ayant un nombre élevé d'élevages de porcs par rapport aux élevages de bovins. La structure des élevages semble jouer un rôle important. Les premiers résultats supportent l'hypothèse que les éleveurs ayant des bovins et des porcs ont probablement affouragé leurs animaux plutôt avec des aliments destinés aux porcs que dans les régions où les exploitations de porcs sont séparées de celles de bovins. Toutefois, la combinaison de plusieurs facteurs de causalité reste possible et demande de plus amples investigations.

INTRODUCTION

In 1990, the first Swiss BSE case was diagnosed at the BSE reference center (School of Veterinary Medicine, Bern). As of March 21, 1997, 246 cases have been confirmed all over the country out of 604 suspects, including 21 cases born after the feed ban (BABs). The annual incidence rate per 100,000 dairy cattle was 1.2 in 1991, 2.0 in 1992, 3.9 in 1993, 8.4 in 1994 and 9.1 in 1995. The epidemic started declining first in 1996 (incidence rate 6.0) possibly showing the efficacy of the ban on feeding ruminants with meat-and-bone meal (MBM) instituted on December 1, 1990. The 246 cases, all born in Switzerland (CH), occurred on 236 dairy cattle farms. Approximately 2/3 had always remained in their natal herd and 1/3 had changed ownership at least once. The average age at the time of diagnosis was 5.3 years.

Dairy cattle feed concentrates in Switzerland contained approximately 2.6% of MBM until November 1990. The origin of the Swiss BSE epidemic was most likely associated with imported feed components (Hornlimann et al., 1994a, 1994b). According to laboratory controls the feed ban was immediately implemented by the feed companies. Therefore, the occurrence of BABs seemed not to be consistent with the feed-born hypothesis. Consequently an in-depth field investigation of all 21 BABs recorded on 20 farms was carried out; preliminary results are presented here.

MATERIALS AND METHODS

Data were obtained from August 1996 to March 1997 using a standard questionnaire completed during personal interviews with the owners of all 20 farms involved. The questions asked were whether there was evidence of vertical transmission, iatrogenic transmission or other ways of transmission, and whether feedstuff-related risk factors could have been involved in transmission. For BABs which had changed ownership, a risk factor was considered present if it was present on at least one of the farms involved. Only risk factors present in >50% of the cases were considered relevant and are therefore discussed in this paper.

RESULTS

Descriptive statistics are presented in Tables I to III (figures are rounded). Sixteen out of 21 BABs had always been kept on the same farm, 4 changed ownership once, and one twice. BABs were born between December 10, 1990 and August 1, 1993. The average age of the BABs at the time of diagnosis was 4.3 years, i.e. one year younger than that of cases born before the feed ban (BBBs). There was no evidence for two or more BABs having had a common dam or common sire, or having had contact with each other on common alping pastures; nor was there evidence for the owners of these animals having had regular exposure to a given plant or factory (e.g. an abattoir) from which infectious material could have been transferred to the farm. On the farm where 2 BABs were recorded, the affected animals were born in the same barn and within 3 days; in addition, they were always kept together whether inside or on pastures or alping pastures.

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Table I
Summary of most important findings on potential relevant transmission factors (risk factors)

Transmission mode	Questions addressed	Point of major interest of question addressed	Number (100%)	Yes %	"?" %	No %
Vertical	Dam of BABs	ever showed neurological signs	21	0	11	89
Iatrogenic	Eye surgery	carried out on BABs	21	5	5*	90
	Hormones	administered to BABs, all types	21	19	19	62
	Farmer practiced injections to BAB	once or several times; parenteral (all types, for example antibiotics)	16**	25	31	44
	BAB was vaccinated	once or several times; all types	21	47	10	43
Horizontal	Exp. to BSE case	more than one case on same farm	20 farms	5	0	95
Horizontal: pot. transmission via human contact	Farmer working part-time with pot. infectious tissue	• Feed producer	20 farmers	5	0	95
		• Feed mixer	20 farmers	5	0	95
		• Abattoir	20 farmers	5	0	95
Horizontal: pot. transmission via animal contact (placental tissue)	Goats or sheep on affected farm or on neighbor's pasture touching the farm	• Goats	21	52	0	48
		• Sheep of passage	21	52	0	48
		• Sheep	21	67	0	33
Oral transmission exposure (exp.) to pot. infectious feed concentrates	Cattle feeding practices in respect of concentrates, as stated by farmers	• By intention: poultry feed	21	5	0	95
		• By intention: pig feed	21	10	0	90
		• Possible exposure of any feed not destined for cattle	21	23	23	54
		• Fed ruminant concentrates	21	100	0	0
Oral transmission exposure to non-ruminant species (feed which could contain MBM etc.)	(the presence of a species led to the assumption that BABs could be exposed to respective feed stock)	• Poultry	21	57	0	43
		• Pigs	21	62	0	38
		• Pigs or poultry	21	86	0	14
		• Domestic cats	21	100	0	0

(Abbreviations: pot. = potential / potentially; „?" = don't know (answer); sp. = species; MBM = meat-bone meal; *one missing value; **asked only from 6th BAB case onwards; feed: concentrated feeds (generally in the paper).

Figure 1
The presence of potentially relevant transmission factors in Swiss BABs

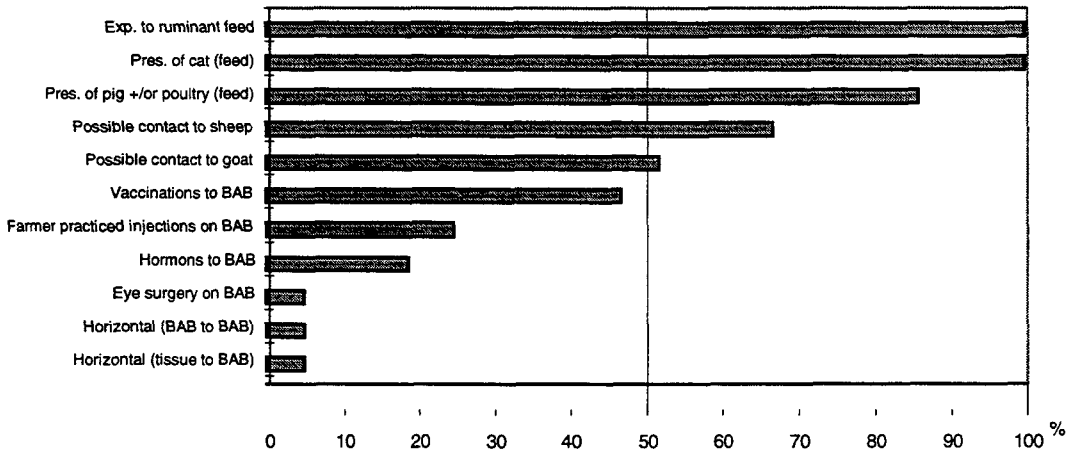

Table II : Distribution by breed

	% Breed in cattle pop.	BAB %	BSE %
BV/BS	41	71	45
HF	12	5	8
SIxRH	44	24	46
Other*	3	0	1

HF: Holstein-Frisian, SIxRH: SimmentalxRH, BV/BS: Braunvieh and Brown Swiss, *Eringer

Table III : Distribution by geographic region

	Pig/dairy-cattle-ratio	% of dairy cattle pop.	BAB %	BSE %
LU	4.8	11	30	10
TG+SG	3.5	16	10	10
BE	2.0	20	10	20
Rest of CH	1.4	53	50	60

LU: Lucerne, TG+SG: Thurgau and St. Gall, BE: Bern, CH: Switzerland, pop.: population. Source: BfS (1993)

Unlike BBBs, there is a trend that BABs occurred more in Braunvieh and Brown Swiss breeds (Table 2), and geographically clustered: 30% of all BABs were recorded in the Canton of Lucerne (LU) where mainly Braunvieh and Brown Swiss (BV/BS) are kept, 10% in the Cantons of Thurgau and St. Gall (TG+SG) with mainly BV/BS, 10% in the Canton of Bern (BE) and 50% in the rest of Switzerland (Table 3).

DISCUSSION AND CONCLUSIONS

1) The findings may indicate an association between some BABs and exposure of dairy cattle to pig or poultry feeds with or without intention. Focusing on the pig feed hypothesis, it is noteworthy that the Cantons LU, TG+SG and BE are holding 66% of Swiss pigs. In LU with a high pig/dairy-cattle ratio the BAB incidence is higher than in other Swiss regions. This leads to the following hypothesis: the presence of pigs is an indicator for the presence of a BSE risk whereas the true risk factor is the presence of BSE infectivity in pig feeds accessible to calfs, heifer or dairy cattle. On the other hand, this new hypothesis seems not to be supported when focusing on TG+SG, with no higher BAB incidence than for example in BE (with a pig/dairy-cattle ratio approximately half of that in TG+SG). The most likely explanation for this paradox is that in TG+SG - in contrast to LU - the farming structure is different. In TG+SG, 2,600 pig owners are holding 430,000 pigs (mean: 165 pigs/farm; often on premises without dairy cattle) whereas in LU, a large proportion of the 4,200 pig holders (keeping 390,000 pigs; mean: 93 pigs/farm) keep dairy cattle on the same premises. In addition, in LU, ownership of the pigs is different compared to other regions: farmers are often in contract (Lohnmast) with feed mills who own the pig and pay the farmer for their work and for providing the barn. The feed mills, on the other hand, provide the farmer with pig feed free of charge „for their pigs" (personal communication, Infanger, 1997). Therefore it could be a plausible consequence that farmers profit of having „free" pig feed on the premises and eventually feed their dairy cattle with it. This hypothesis should further be investigated.

2) The breed data seems to be confounded by the geographic distribution of dairy cattle breeds. Since BABs occur more likely in regions with mainly BS/BV, a breed predisposition is not very likely.

3) An explanation for some cases could be the exposure to ruminant feeds, since some of these products could have been cross-contaminated: the production of pig (or poultry) feed which legally may contain MBM and the subsequent production of ruminant feeds in the same feed mixing plant could lead to cross-contamination (Vicari et al., 1996). Skulls of clinically inapparent BSE-infected cattle entering the feed production chain were the probable source of the BSE agents. Even with wet heat application of 133°C during 20 minutes at 3 bar pressure (as applied in Swiss abattoir waste rendering), remote BSE-infectivity may have remained in the product (MBM) until 1996 (Vicari et al., 1996). Since May 1996, all skulls of adult cattle slaughtered in Switzerland must be incinerated by law. Thus zero risk should be achieved by now from this point of view.

4) According to information from the feed companies there is a higher concentration of MBM in pig and poultry feeds (5 to 15% MBM) than there used to be in cattle feeds prior to 1991. Thus the quantity of infectious units per gramme is probably higher in pig and poultry feeds. This is of interest in the context of these data since the average age of BABs is one year below the age of BBBs. It may be that the infectious dose was higher in BABs. It is well known, that the length of the incubation period of spongiform encephalopathies is generally inverse to the accumulated infectious dose. Therefore it is plausible that the threshold leading to the onset of clinical signs is reached after a shorter incubation period, i.e. in a younger age, if the infectious dose is higher.

5) As Switzerland is practically scrapie-free (Hornlimann et al., 1996), exposure of BABs to scrapie infectivity can almost be excluded, despite quite frequent contact to sheep or goat (placenta). Farms involved in a BAB case and their neighbors have never recorded a scrapie case.

6) Domestic cats are usually present on farms and therefore the result regarding this factor is not of surprise. The question which should be raised is whether there is dry pet food stored in large bags in the barn with potential accessibility for dairy cattle. This should be investigated in future as pet food may contain MBM.

7) Finally, it should be mentioned that the occurrence of spontaneous or sporadic BSE cases cannot be excluded, but there is no possibility to provide evidence for the existence of this "cause" at this stage. However, some BABs may turn out to be such cases years later, when the main BSE epidemic is over.

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