

Application of animal cloning data to human cloning

Ian Wilmut

**Roslin Institute
Scotland**

How does animal science apply to the cloning of people ?

- **Summary of published results**
- **Information from casualties**
 - **Specific cases**
 - **Pathology (Dr Susan Rhind)**

Somatic Cell Nuclear Transfer Data (August 2001)

Species	No Oocytes	Embryo transfer	Live Offspring	Died	Survived
Mice (7)	17,491	6842	159 (+ 7 stillborn)	29 18%	130
Cow (13)	8,919	742	71	26 37%	45
Sheep (3)	956	136	11 (+3 stillborn)	3 27%	8
Goat (3)	785+	427	16	6 38%	10
Pig (3)	2,856	1244	10	0	10

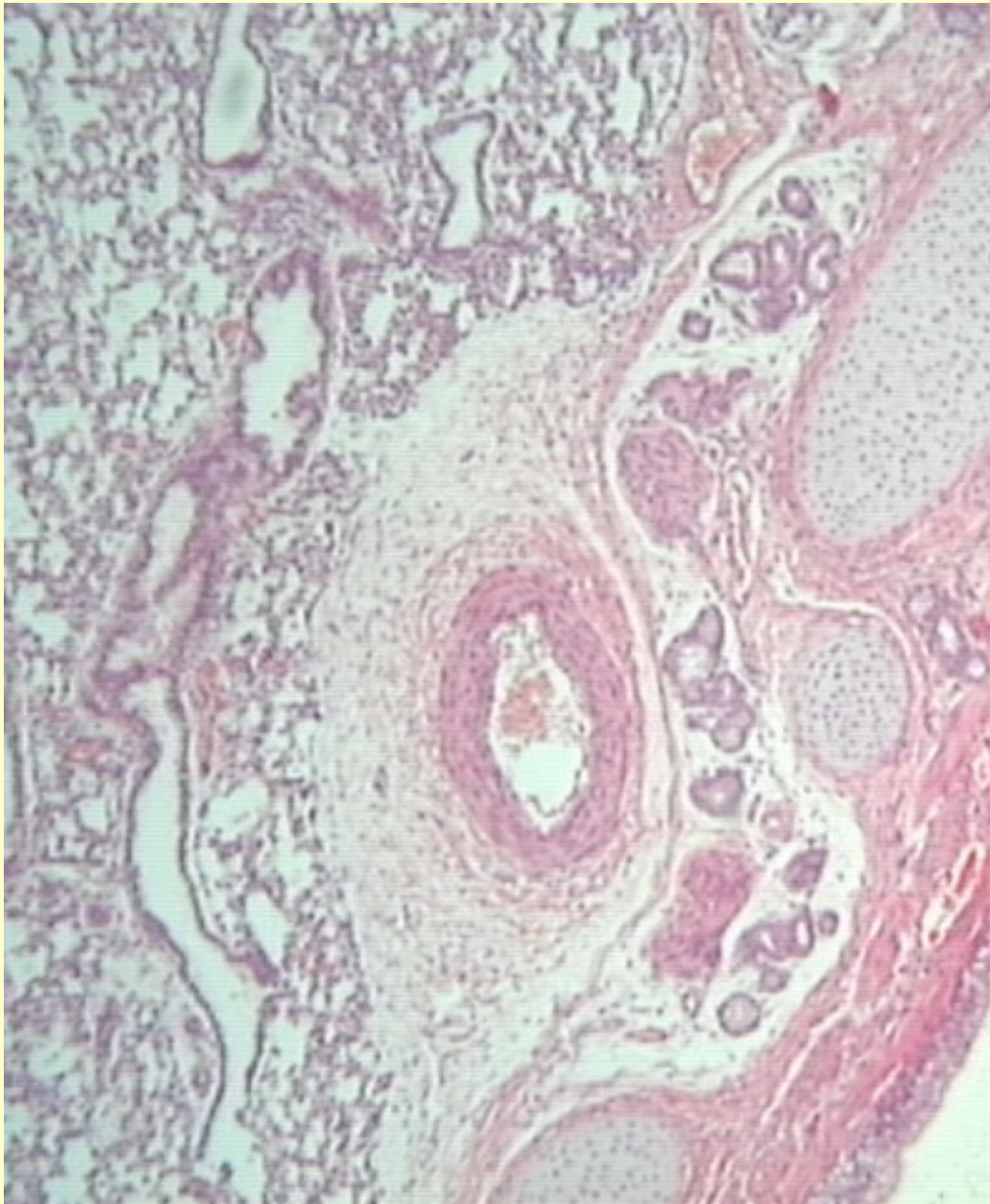
Not all clones are healthy

- **Calf cloned from skin cell**
 - **Died day 51 after birth**
 - **thymic atrophy & lymphoid hypoplasia**
- **Surviving cloned calves variable**
- **Epigenetic effects ?**

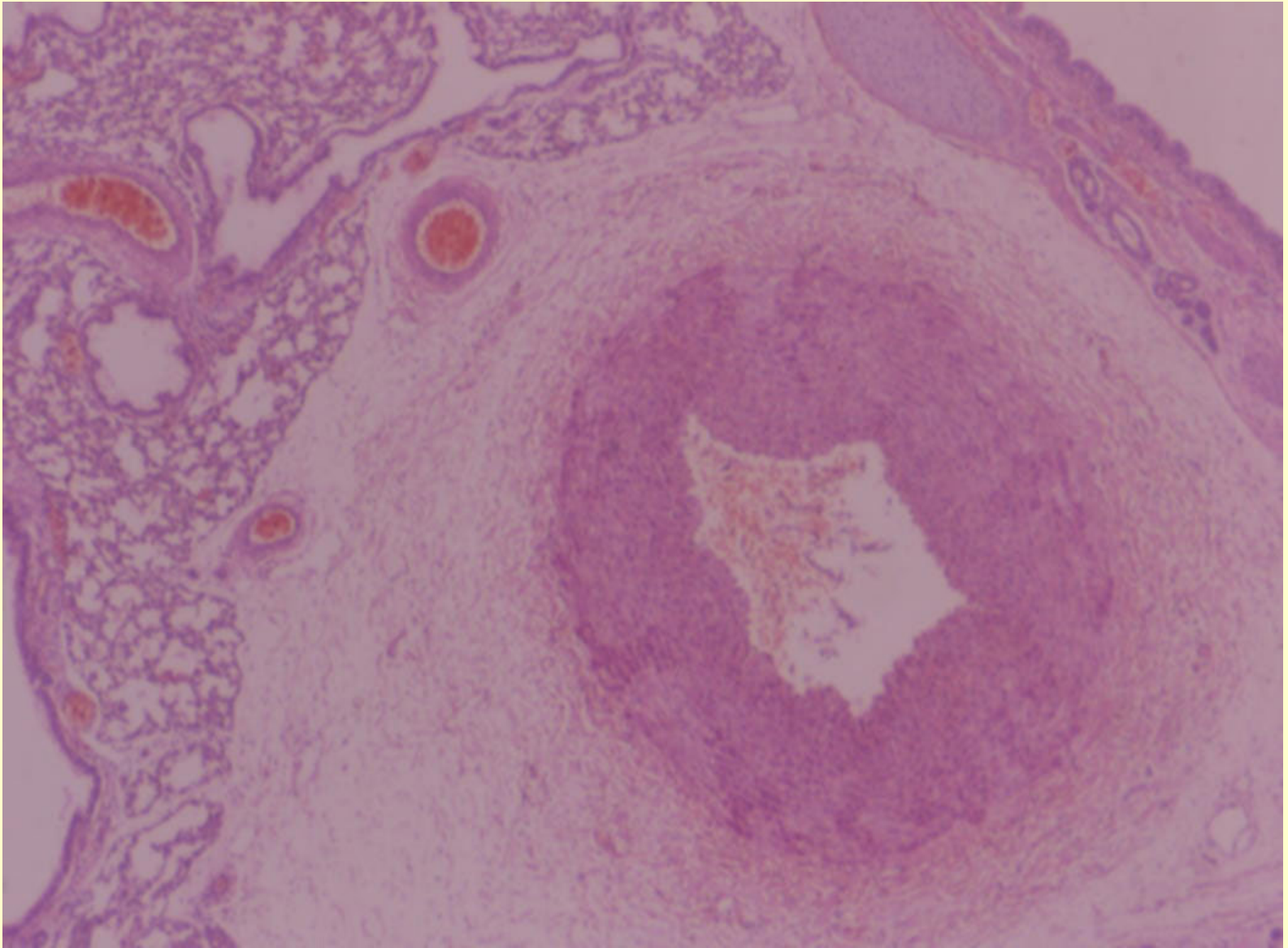
Cloned lamb at Roslin

- **Well formed lamb**
- **Very active, strong**
- **Ate well and gained weight**

- **Hyperventilated**
- **Pulmonary hypertension**

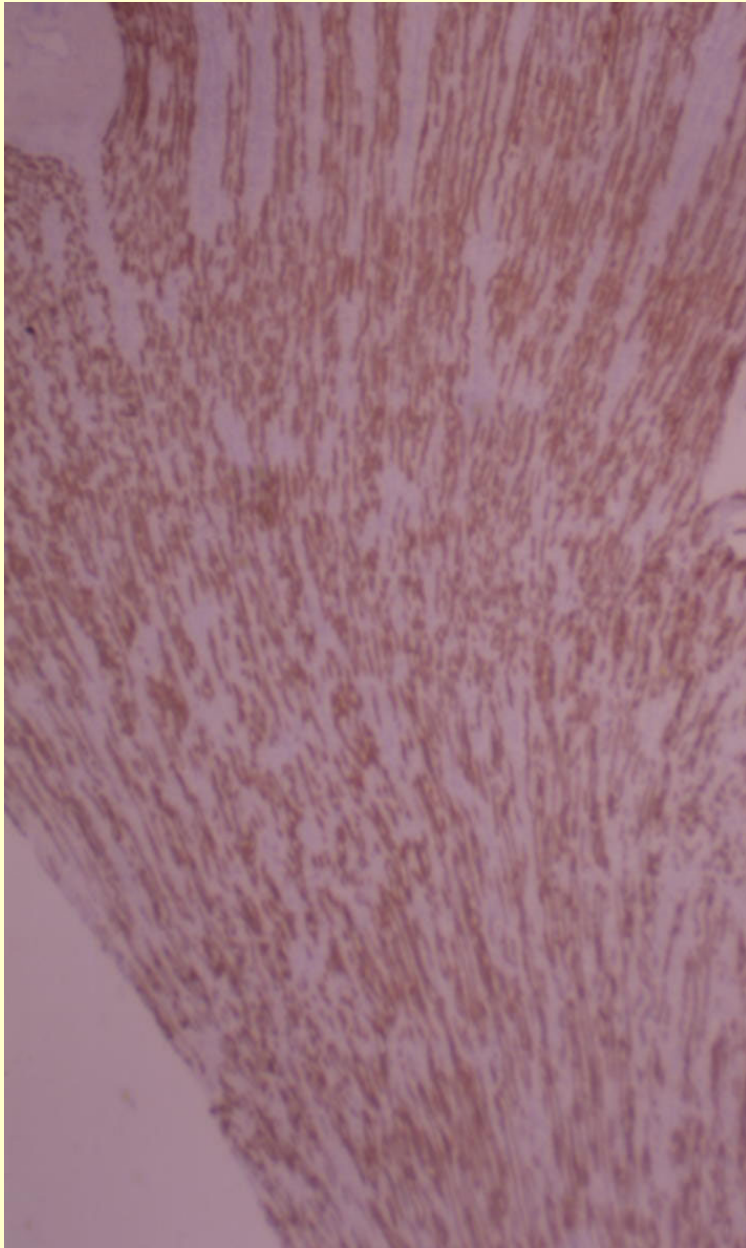


**Typical
lung
tissue**

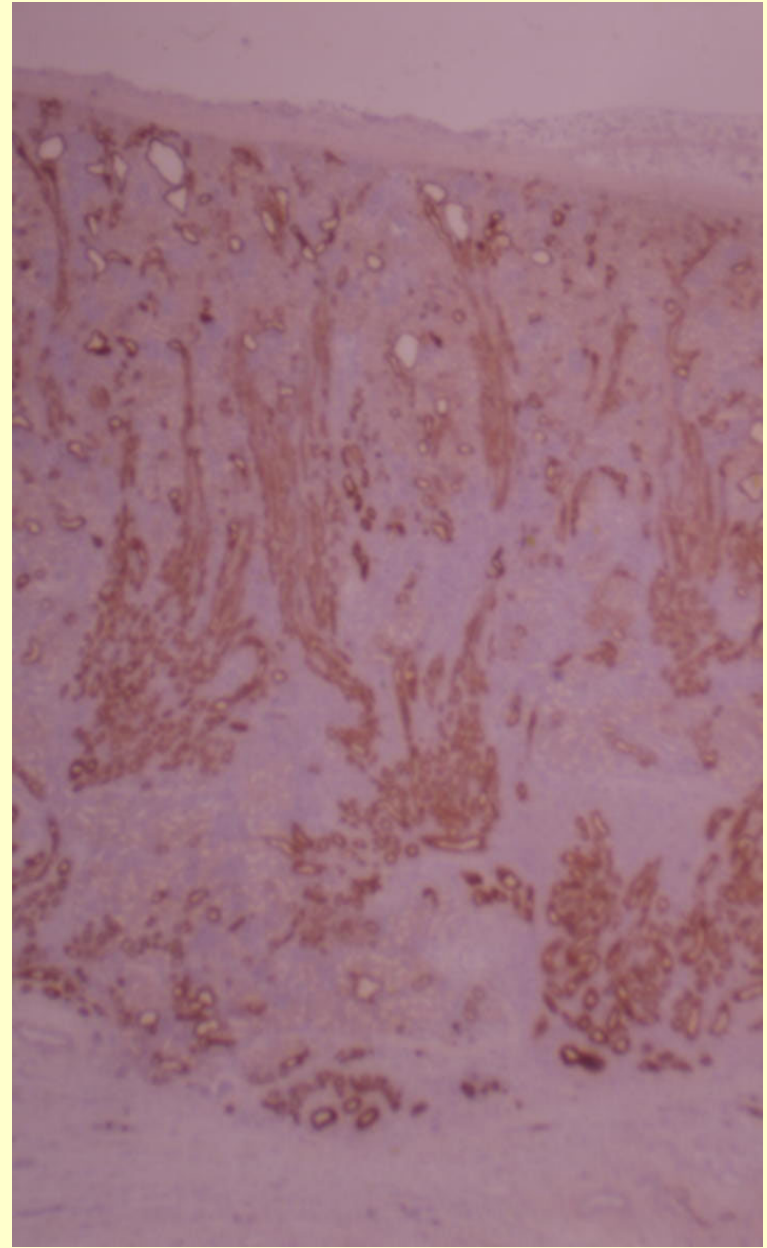


Abnormal lung tissue

KIDNEYS - CYTOKERATIN IMMUNOHISTOCHEMISTRY



CONTROL



NT

How does animal science apply to the cloning of people ?

- **Very inefficient in all species**
- **Some abnormalities only in clones**
 - **Some not detectable in utero**
- **Expect similar outcome in humans**

Are there any reasons to that cloning procedures cannot be made safer and more efficient ?

- **No**

- **But we need an advance equivalent to that which gave us adult clones**

What would be a safe basis for cloning in humans ?

- **Safe and effective cloning**
 - **in several species**
- **And**
- **Normal gene expression in human embryos**

What is most difficult task to overcome in making cloning safer and more efficient ?

- **Extended period of mortality suggests : -**
 - **Inappropriate expression of many genes**
 - **Several mechanisms involved**

Would results with human cloning attempts resemble one animal species rather than another ?

- **Differences between species**
 - Rats and mice
 - Cattle and sheep
- **Similarities unpredictable**

General comments

- **Attempts to clone people**
 - **Outcome same as in other species**
 - **Screening ineffective**
- **Hence expect :-**
 - **Late abortions, dead children**
 - **Surviving, but abnormal children**