A Neonatal Piglet Brain Database with High Resolution MRI

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Introduction

- Piglet is a good preclinical model for studying human nutritional physiology and neuroscience.

  Saikali *et al.*, Journal of Neuroscience Methods. 2010

- Comparing to the primate brain which is though to be close to human brain, the development pattern of piglet brain is much similar to the human brain.

  Dobbing *et al.*, Early Human Development. 1979

- Magnetic resonance imaging for in vivo assessment of brain development in young piglets was performed.

  Radlowski *et al.*, PLOS ONE. 2014

  Conrad *et al.*, Developmental Neuroscience. 2012

- However, the features of piglet brain growth and development have not been well established at the neonatal stage.

Purpose

We aim to generate a neonatal piglet brain database at ages of less than 12 days old using high resolution MR images obtained with ultrahigh field MRI.
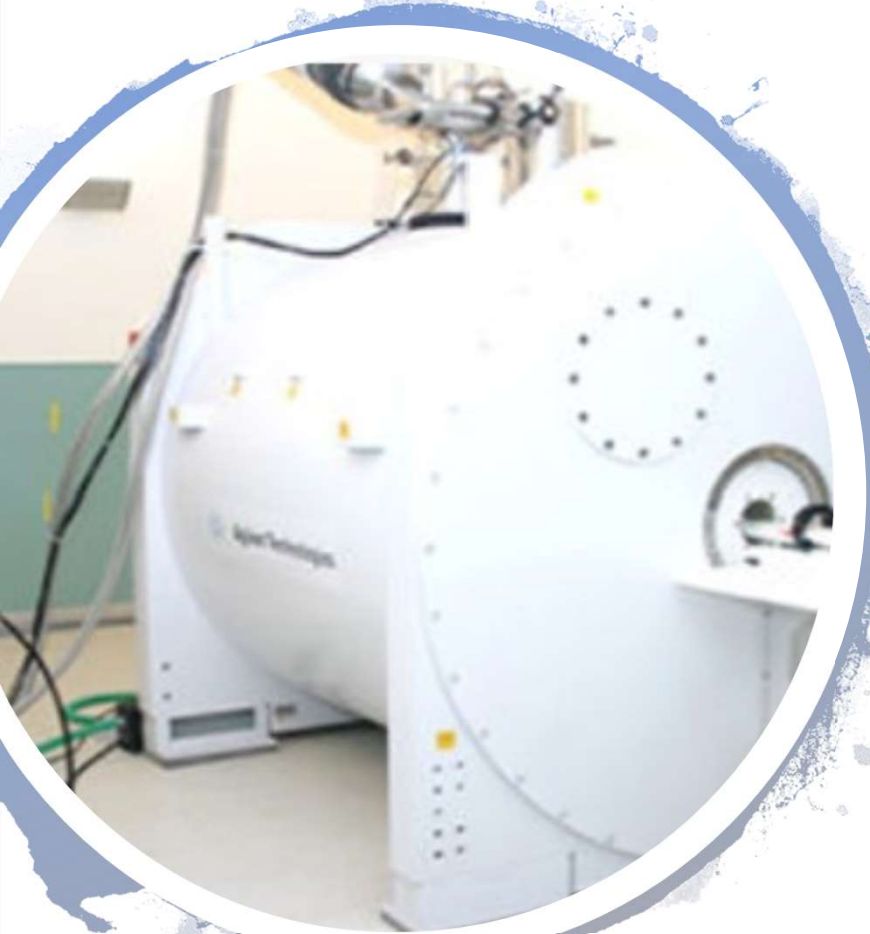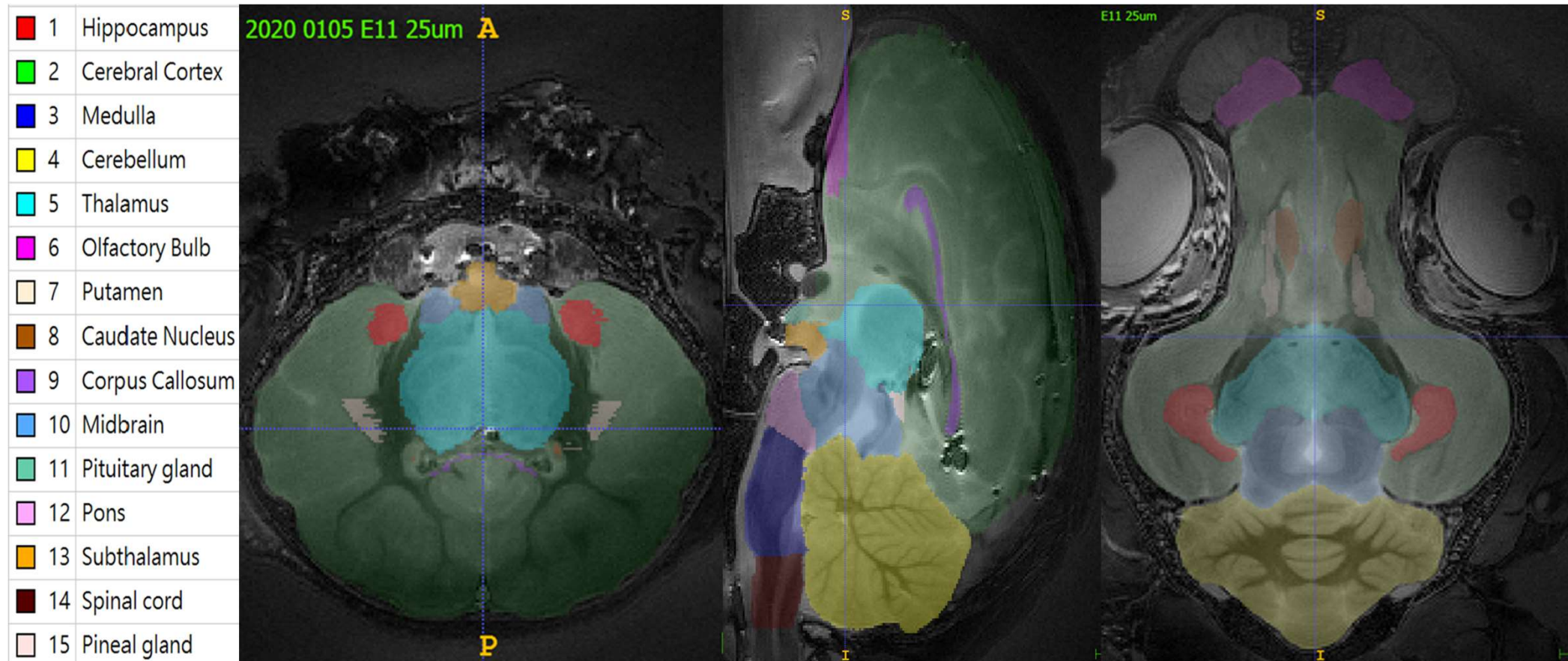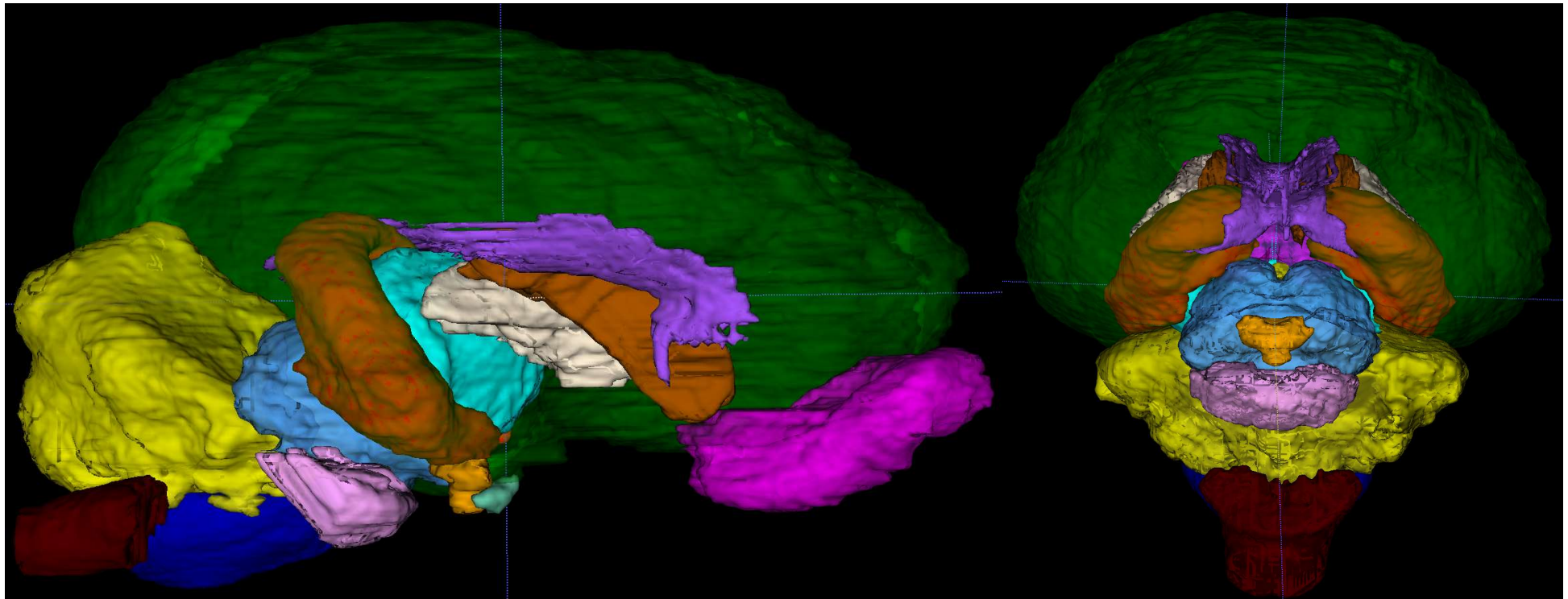
Materials and Methods

- **Sample:**
  - Nineteen piglet brains were harvested with skull at the age of 12 days.

- **MRI:**
  - 9.4 T MRI and a 72 mm ID birdcage RF coil.
  - A 3D fast spin echo with T_2 weighted sequence was applied.
  - Parameters: TR/TE =1500/46 ms, ETL= 16, image resolution = 250 × 250 × 250 um^3, Total scanning time was 1 hour 42 minutes.

- **Image Processing:**
  - Fifteen major structures in each brain were segmented with the ITK-SNAP software (Version 3.8.0).
  - The volume of each structure and the whole brain volume were obtained.

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Fifteen piglet brain structures were segmented with different labels

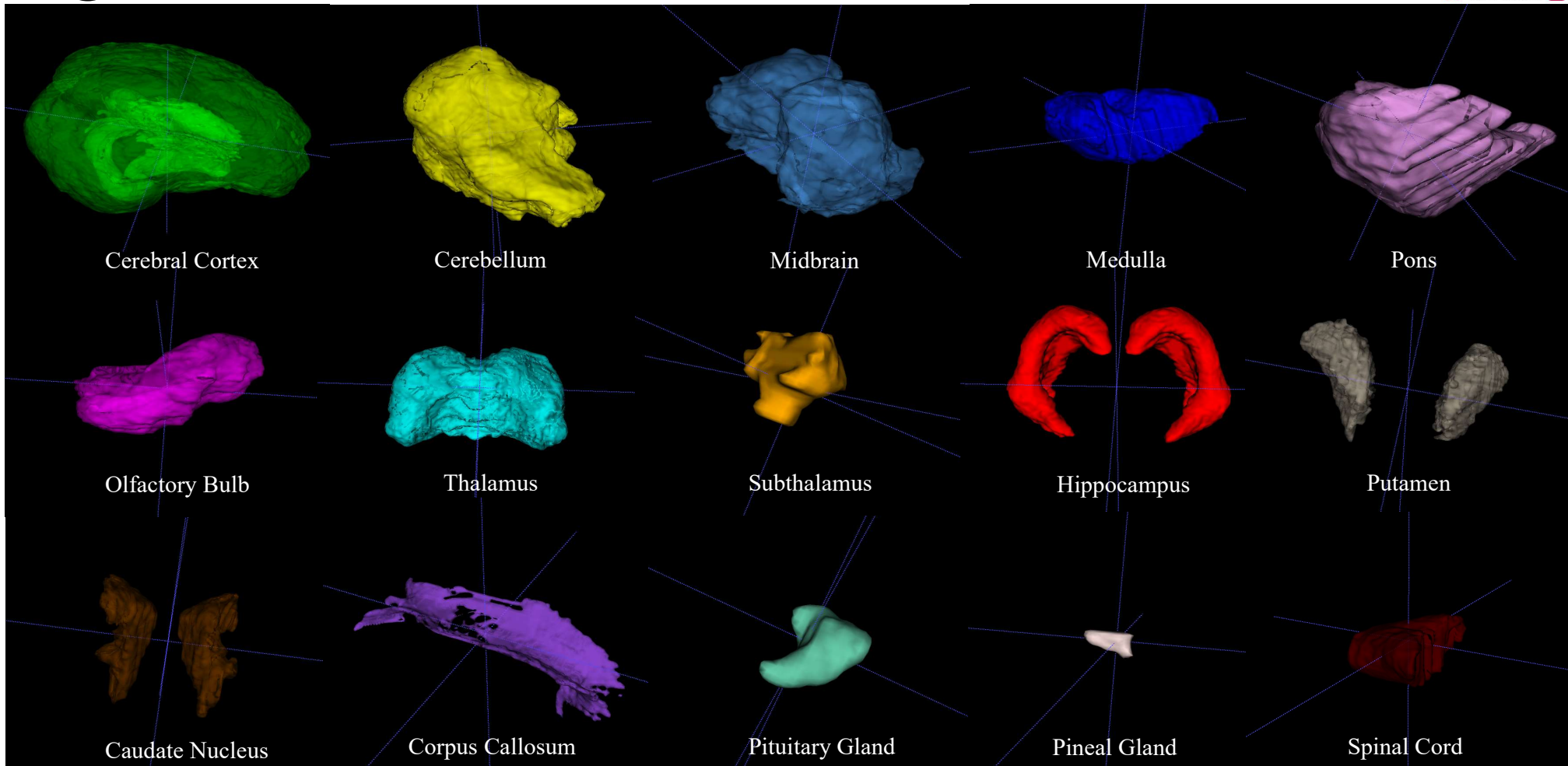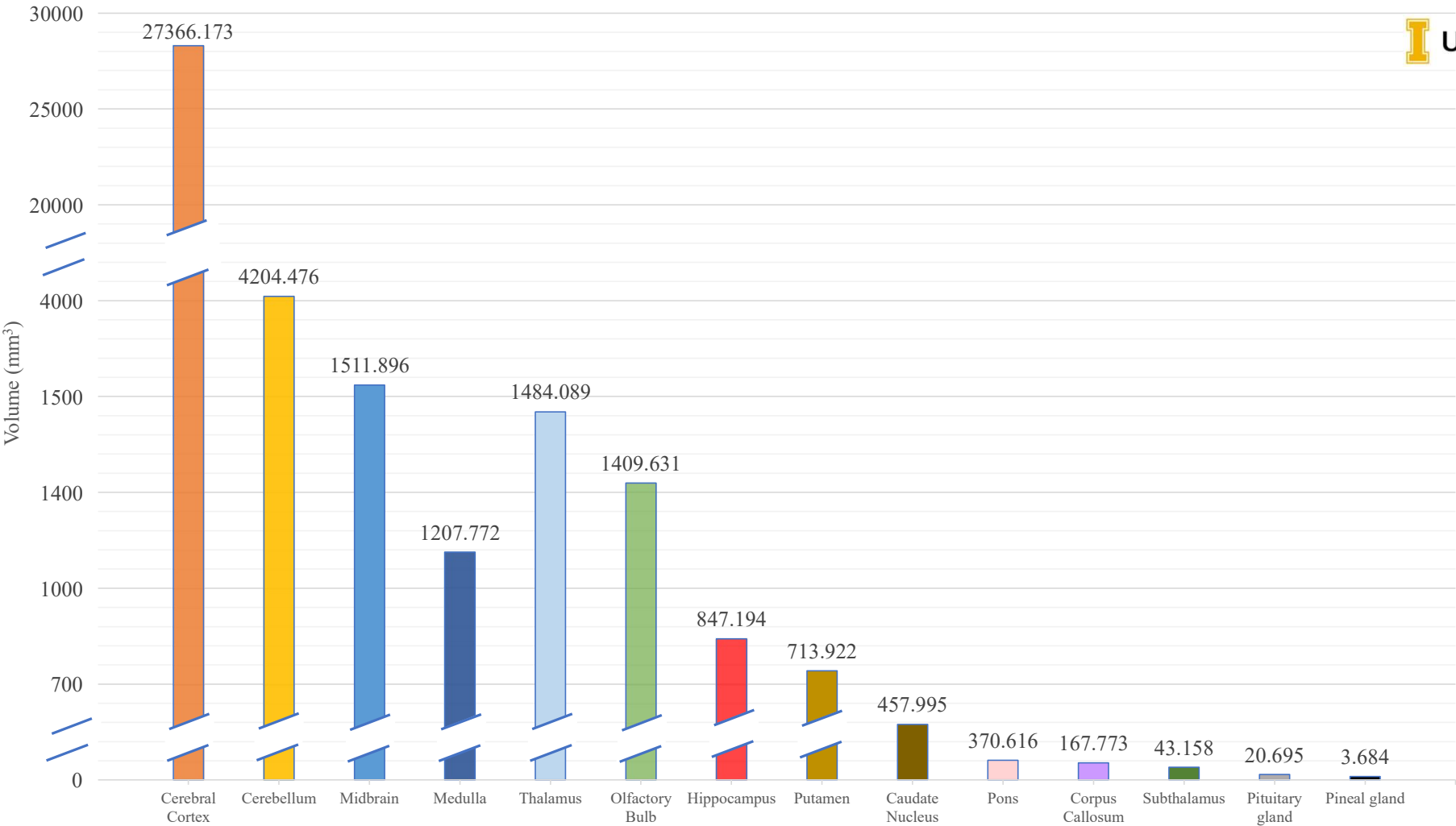|		
🟥	1	Hippocampus
🟩	2	Cerebral Cortex
🟦	3	Medulla
🟨	4	Cerebellum
🟦	5	Thalamus
🟪	6	Olfactory Bulb
⬜	7	Putamen
🟫	8	Caudate Nucleus
🟪	9	Corpus Callosum
🟦	10	Midbrain
🟩	11	Pituitary gland
🟪	12	Pons
🟧	13	Subthalamus
🟥	14	Spinal cord
⬜	15	Pineal gland

3D brain atlas reconstructed from MRI image

- These 3-dimensional piglet brain atlas were reconstructed through ITK-Snap (3.8.0 Version) software that shows fifteen piglet brain structures.
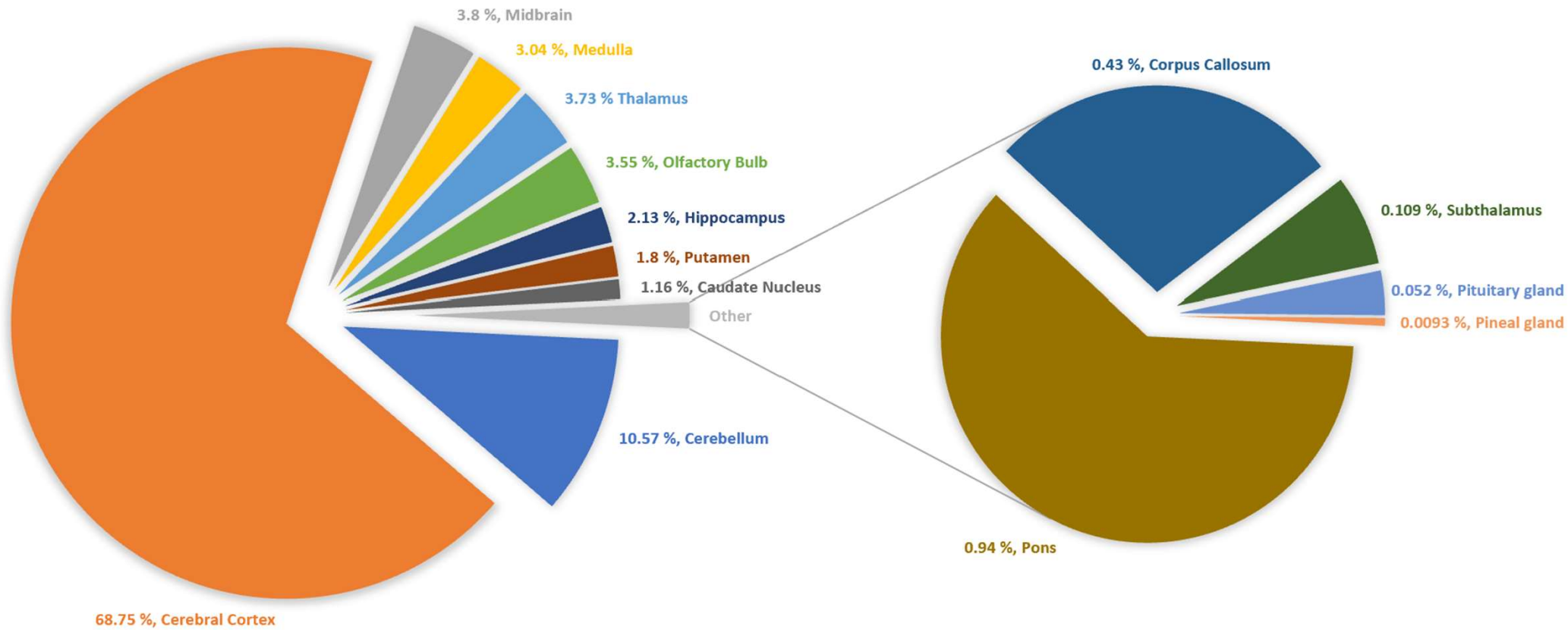
Piglet brain structures

Cerebral Cortex

Cerebellum

Midbrain

Medulla

Pons

Olfactory Bulb

Thalamus

Subthalamus

Hippocampus

Putamen

Caudate Nucleus

Corpus Callosum

Pituitary Gland

Pineal Gland

Spinal Cord

Piglet Brain Structural Mean Volume

Piglet brain Structural Percentile

Conclusion and Future Works

- The brain structures segmented in this study could provide references and could develop methods for in vivo assessment of brain growth and development in metabolic and pediatric nutrition research.

- Ongoing studies will characterize reliable estimates of changes in the brain volume at early neonatal period.