

# Frontal Base Endodermal Cyst: A Case Report and Review of Literature

Akito OSHIMA,<sup>1</sup> Katsumi SAKATA,<sup>1</sup> Kosuke ISHIKAWA,<sup>1</sup>  
Hiroshi MANAKA,<sup>1</sup> and Takashi KAWASAKI<sup>1</sup>

<sup>1</sup>*Department of Neurosurgery, Yokohama City University Medical Center,  
Yokohama, Kanagawa, Japan*

## Abstract

**Background:** Endodermal cyst (EC) is a rare congenital cyst of endodermal origin, but the pathogenesis of this entity remains uncertain. Supratentorial EC is particularly uncommon, but some cases have been reported. Here, we report a case of supratentorial EC that developed at the frontal base which indicates posttraumatic development rather than a congenital origin. **Case Description:** A 65-year-old man who had a history of orbital bone fracture without rhinorrhea sustained in a traffic accident presented with gradually enlarging frontal-base cystic lesions. Multiple cystic lesions were removed via left frontal craniotomy. The cysts showed no communication with the frontal sinus. Histological examination identified EC. Postoperative course was uneventful and no recurrences have been identified as of 2 years later. **Conclusions:** According to reported cases, unlike ECs in other intracranial locations, frontal base ECs tend to present at advanced ages. The present case also presented with EC enlargement at an advanced age and two lesions located at the bone hiatus in the frontal base that were presumably caused by trauma. It is possible that sinus communication was repaired as the bone fracture was remodeled, and the remnant sinus epithelial tissues developed into ECs over time. This situation makes it reasonable to presume a posttraumatic rather than a congenital origin. In conclusion, as for frontal base ECs, contrary to the traditional theory, the developmental mechanisms may not necessarily be congenital.

Keywords: endodermal cyst, neurenteric cyst, supratentorial, frontal base

## Introduction

Endodermal cysts (ECs), also called neurenteric cysts, are rare congenital lesions comprising epithelium of mucin-secreting and/or ciliated, cuboidal to columnar cells with underlying connective tissue.<sup>1–3)</sup> This pathology is usually located along the neuroaxis, typically found in the ventral spine or posterior fossa, and rarely supratentorially.<sup>3–5)</sup> Among supratentorial ECs, frontal base ECs are particularly uncommon. Various origins of supratentorial EC have been hypothesized, but the pathogenesis remains uncertain. Here, we report a case

of frontal base ECs that developed on an anterior cranial fossa fracture. Although EC is considered congenital, the present case and some previously reported cases of frontal base EC pose the possibility that frontal base ECs have an acquired origin.

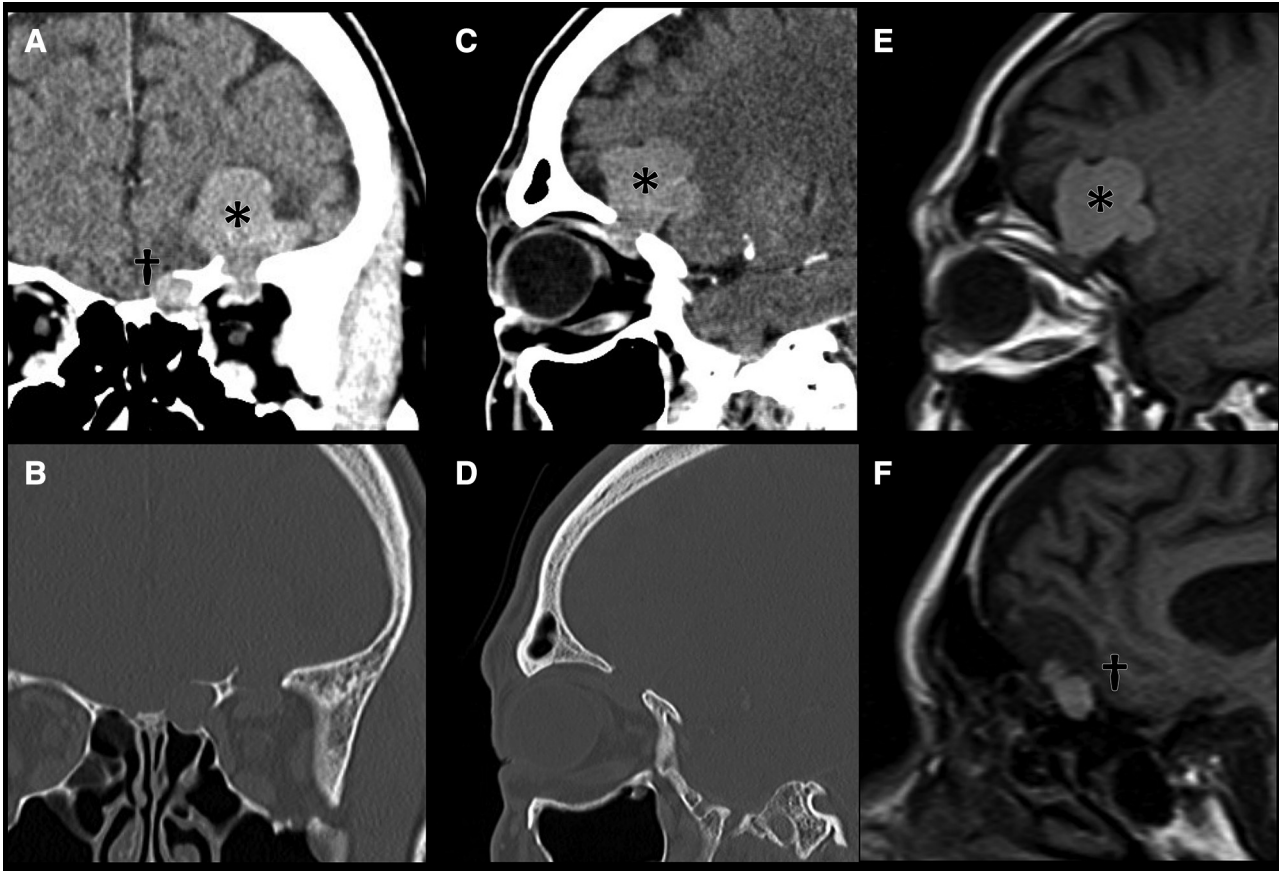
## Case Presentation

A 65-year-old man presented with two gradually enlarging cystic lesions at the frontal base, initially identified when he had suffered left putaminal hemorrhage 10 years earlier. He also had a history of left supraorbital fracture without rhinorrhea sustained in a traffic accident at 18 years old. Neurological examination revealed nothing but mild right hemiparesis, which was considered an after-effect of the putaminal hemorrhage. Computed tomography (CT) revealed slight hyperdensity of the two masses without contrast enhancement.

---

Received September 11, 2020; Accepted October 22, 2020

Copyright© 2021 by The Japan Neurosurgical Society This work is licensed under a Creative Commons Attribution-NonCommercial-NoDerivatives International License.



**Fig. 1** Imaging for present case. (A–D) Plain CT images. (E, F) Plain T1-weighted MRI. (A, B) Coronal CT shows both the larger lesion (\*) and the smaller lesion (+) located on the remodeled frontal base. (C, D, E) Sagittal images reveal the larger lesion located on the fractured part of supraorbital bone and partially involving the intraorbit. (A, B, F) The smaller lesion is sandwiched between remodeled medial frontal base bone. CT: computed tomography, MRI: magnetic resonance imaging.

The larger mass was located only on the bone deficit of the supraorbital fracture and partially involved the intraorbit. The smaller mass was located in the remodeled frontal base (Fig. 1). Magnetic resonance imaging (MRI) showed an isointense lesion with a hypointense component on T2-weighted imaging. Mild perifocal edema was observed on fluid-attenuated inversion recovery (FLAIR) imaging.

Tumor removal was performed for diagnosis and treatment. Left frontal craniotomy was performed, and we identified the two cysts were extra-axial and developing from the frontal base dura. Parts of the cyst wall were adherent to the brain surface, but the pia mater was not involved. The cyst was detached and removed from the dura and yellowish fluid was identified from inside the cyst. The smaller lesion was also removed in similar fashion (Fig. 2). Neither communication with paranasal sinuses nor spinal fluid leakage were identified for each lesion. The defect in the frontal base dura

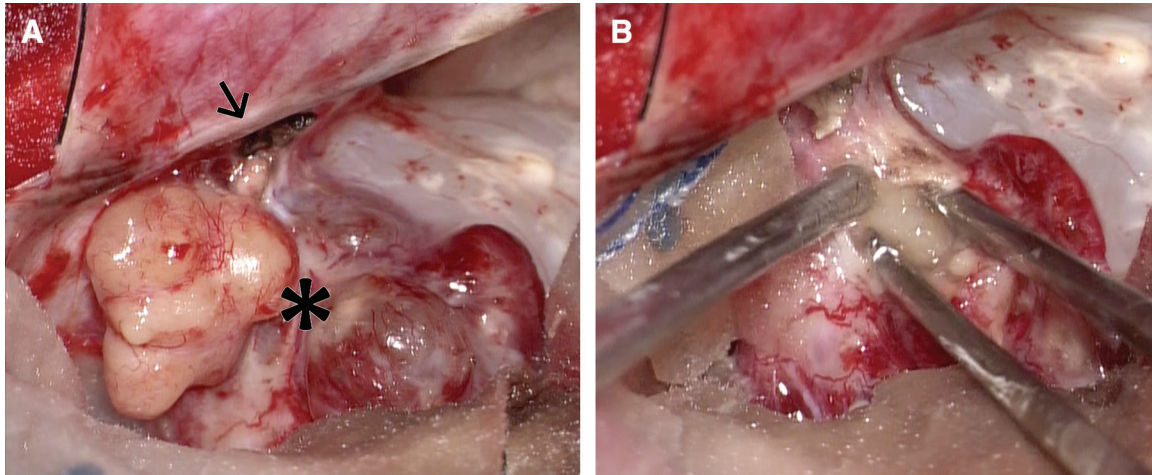
was repaired with temporal fascia, periosteum, and fibrin glue.

Histological examination revealed that the cyst wall comprised fibrous connective tissue mainly covered with a layer of ciliated pseudostratified columnar epithelium. Epithelial cells were immunopositive for epithelial membrane antigen (EMA). No malignancy was identified. Periodic acid-Schiff (PAS) staining and Alcian blue staining showed scattered goblet cells and staining for multiple subtypes of mucin showed few positive cells. These findings were consistent with EC (Fig. 3).

Postoperative course was uneventful. The patient has been observed for 2 years, with no recurrence of the lesions as of the time of writing.

## Discussion

EC has been considered congenital, but the pathogenesis of this entity has not been elucidated.



**Fig. 2** Intraoperative photo after left frontal craniotomy. (A) The main lesion (\*) shows irregular development from the frontal base dura (arrow). (B) Yellowish, easily suctioned fluid overflows after making an incision in the cyst wall.

In the present case, considering that cyst enlargement presented at an advanced age and both lesions were located on the bone hiatus from the frontal base, presuming a posttraumatic origin rather than a congenital origin appears reasonable. In this part, the reasons that support the hypothesis will be discussed.

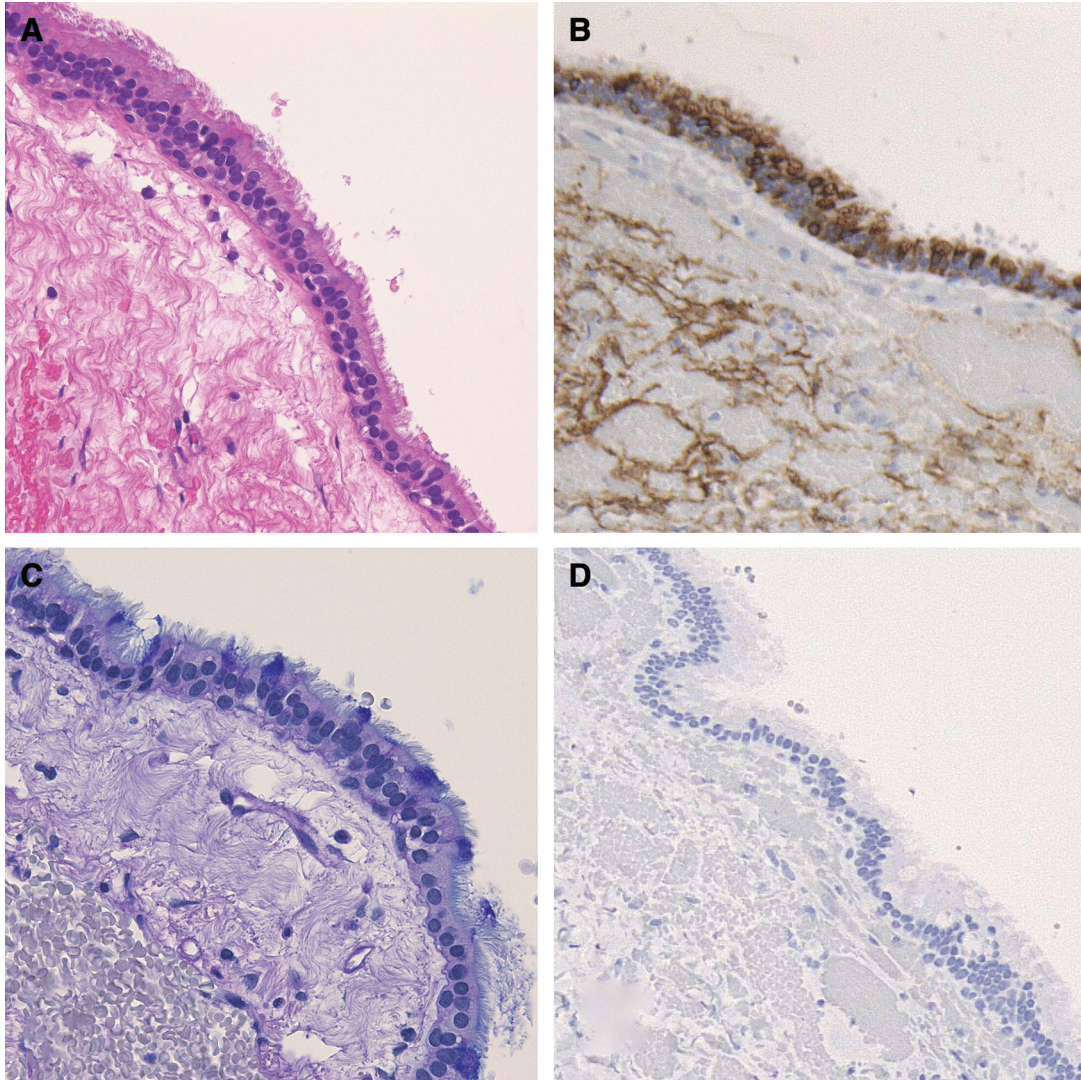
In 1976, classification of ECs based on histological criteria was proposed. ECs were divided into three groups depending on the degree of recapitulation of the gastrointestinal or respiratory tracts.<sup>4)</sup> Type A ECs consist of a single-layer or pseudostratified cuboidal or columnar, ciliated or non-ciliated epithelium mounted on a basement membrane. The complex epithelial walls of type B ECs contain, in addition, various other components that are normally seen along the respiratory or gastrointestinal tract such as mucous or serous glands, smooth muscle, elastic tissue, fat tissue, bone, lymphoid tissue, and, exceptionally, nerve ganglion. Finally, type C cysts may, in addition to constituents of type B cysts, have associated ependymal and other glial elements.<sup>5)</sup> The majority of intracranial ECs are of type A.<sup>6)</sup> In the present case, the cyst wall was covered with a ciliated epithelial layer showing scattered goblet cells and mucin-producing cells mounted on a basement membrane. Cyst wall was negative for immunostaining of desmin: suggesting no contains of smooth muscle. These findings were consistent with EC of type A.

Epidemiologically, ECs are usually reported in the cervicodorsal spine.<sup>7)</sup> When reported intracranially, they are predominantly seen in the posterior fossa.<sup>8,9)</sup> Half of spinal ECs coincide with vertebral anomalies.<sup>6,10)</sup> The most widely recognized and

accepted hypothesis for EC pathogenesis is therefore incomplete endodermal-notochordal separation during the embryological period.<sup>6,8)</sup> However, because the upper limitation to the vertical extent of the notochord is presumed to be the clivus, this hypothesis fails to explain supratentorial development of EC.<sup>11)</sup>

Supratentorial ECs are particularly rare and more than half of the reported supratentorial ECs are located on the convexity. According to reviews of the 35 supratentorial ECs, 27 cases were extra-axial, 6 were intraparenchymal, and 2 were intraventricular. As for the 27 extra-axial supratentorial ECs, 21 cases were on the convexity, 2 were sellar or parasellar, 2 situated at the frontal base, and 1 intraorbitally.<sup>12)</sup> Graziani et al. hypothesized that supratentorial ECs may arise from a remnant of Seessel's pouch, which is an endodermal diverticulum that transiently appears as an outpouching of the embryonic pharynx rostral to the pharyngeal membrane and caudal to Rathke's pouch.<sup>13)</sup> Supratentorial EC, Rathke's cleft cyst, and colloid cyst share indistinguishable histological and immunohistological features, and so may constitute the same entity.<sup>13,14)</sup>

To the best of our knowledge, only three cases of EC developing on the extra-axial frontal base have been reported (Table 1).<sup>11,12,15)</sup> After reviewing these cases and our own patient, we questioned whether the frontal base ECs could be congenital and included under the same entity as supratentorial ECs. The previous three cases and the present case presented at advanced ages (average, 63.3 years; range, 45–72 years). Onset at such advanced ages appears questionable for a congenital condition. As



**Fig. 3** Histopathology slides. (A) Hematoxylin–eosin stain shows the cyst wall lined by ciliated columnar epithelium. (B) The lining epithelium is immunopositive for EMA. (C) PAS stain and Alcian blue stain shows scattered goblet cells. (D) Staining for multiple subtypes of mucin show few positive cells. EMA: epithelial membrane antigen, PAS: periodic acid-Schiff.

for intracranial ECs, a bimodal age distribution is seen, with a small peak in the first decade and a larger peak in the third and fourth decades. The epidemiology of frontal base ECs thus seems to differ from that of ECs at other intracranial locations. Neckrysh et al. reported a 72-year-old patient with frontal base EC who did not have any significant medical history of head trauma, sinus problems, or otolaryngological procedures.<sup>15)</sup> They also questioned the etiology of frontal base EC due to the presentation at advanced age and the lack of a clearly understandable etiology. The hypothesized origin from Rathke's cleft failed to account for this case, as the lesion did not extend to or associate with the stalk or pituitary gland.

The present patient had a history of left orbital fracture 40 years earlier and the ECs had enlarged during the past 10 years. The developmental mechanisms of the ECs in the present case might be interpreted in two ways. First, as previously reported, ECs are congenital lesions that develop from the ectopic remnant of Seessel's pouch, incidentally identified and enlarged at an advanced age. Second, the trauma more than 40 years earlier had presumably induced frontal base and supraorbital fractures that split or sandwiched the endodermal tissues intracranially. If the latter interpretation is correct, since there is no tissue of endodermal origin in the orbit, EC is thought to be derived from the ethmoid sinus epithelium, or from the frontal sinus epithelium that has penetrated

**Table 1** Summary of previous reports of frontal base endodermal cyst

Author	Age/sex	Past history	Symptoms	Location	Cyst size, diameter, mm	Histopathology
Neckrysh et al., 2006 <sup>15)</sup>	72/F	None	Personality change, anosmia	Medial frontal base from crista galli to optic chiasm	50	Pseudostratified columnar epithelium
Chakraborty et al., 2016 <sup>12)</sup>	71/M	–	Worsening vision, frontal bone destruction	Extensive frontal base	64	Pseudostratified cuboidal epithelium, mucus-secreting goblet cells
Arishima et al., 2016 <sup>11)</sup>	45/M	Resection of frontal lobular mass	General convulsion, anosmia	Right frontal base	–	Non-ciliated columnar epithelium, mucin-secreting cells, degenerated hematoma with xanthogranuloma
Present case	65/M	Left orbital fracture due to traffic accident	None	Left frontal base, medial frontal base	25, 8	Pseudostratified ciliated columnar epithelium, goblet cells

the supraorbital wall. The orbit and the ethmoid sinus are separated by a thin ethmoid orbital plate, but it is also known that the anterior and posterior ethmoid canals communicate in some areas without a bony wall, and congenital bone defects are sometimes present.<sup>16)</sup> In this case, although no obvious deformity of the bones in the nasal cavity could be confirmed, the area where the smaller lesion trapped was directly above the ethmoidal sinus and inside the inner wall of the orbit so that the cell of the ethmoidal honeycomb may have been opened at the time of the trauma. Similarly, the frontal sinus does not appear to have penetrated the supraorbital wall on follow-up images, but it is possible that sinus communication was repaired as the bone fracture was remodeled, and the remnant tissues developed into ECs over time.

### Conclusions

Frontal base ECs are very rare condition and the present report added one case. Our review of frontal base ECs suggested that, contrary to the traditional theory, the developmental mechanisms are not necessarily congenital. Further accumulation of cases is needed to properly elucidate the etiology.

### Informed Consent

Informed consent has been obtained from the patient for publication of this manuscript.

### Conflicts of Interest Disclosure

The authors have no conflicts of interest to declare.

NMC Case Report Journal Vol. 8, 2021

### References

- 1) Afshar F, Scholtz CL: Enterogenous cyst of the fourth ventricle: case report. *J Neurosurg* 54: 836–838, 1981
- 2) Tan GS, Hortobágyi T, Al-Sarraj S, Connor SE: Intracranial laterally based supratentorial neurenteric cyst. *Br J Radiol* 77: 963–965, 2004
- 3) Arabi M, Ibrahim M, Camelo-Piragua S, Shah G: Supratentorial neurenteric cyst mimicking hydatid cyst: a case report and literature review. *Avicenna J Med* 3: 73–80, 2013
- 4) Mittal S, Petrecca K, Sabbagh AJ, et al.: Supratentorial neurenteric cysts—a fascinating entity of uncertain embryopathogenesis. *Clin Neurol Neurosurg* 112: 89–97, 2010
- 5) Preece MT, Osborn AG, Chin SS, Smirniotopoulos JG: Intracranial neurenteric cysts: imaging and pathology spectrum. *AJNR Am J Neuroradiol* 27: 1211–1216, 2006
- 6) Bejjani GK, Wright DC, Schessel D, Sekhar LN: Endodermal cysts of the posterior fossa. Report of three cases and review of the literature. *J Neurosurg* 89: 326–335, 1998
- 7) Baek WK, Lachkar S, Iwanaga J, et al.: Comprehensive review of spinal neurenteric cysts with a focus on histopathological findings. *Cureus* 10: e3379, 2018
- 8) Harris CP, Dias MS, Brockmeyer DL, et al.: Neurenteric cysts of the posterior fossa: recognition, management, and embryogenesis. *Neurosurgery* 29: 893–897; discussion 7–8, 1991
- 9) Tucker A, Miyake H, Tsuji M, et al.: Neurenteric cyst of the lower clivus. *Neurosurgery* 66: E224–225, 2010
- 10) Mackenzie IR, Gilbert JJ: Cysts of the neuraxis of endodermal origin. *J Neurol Neurosurg Psychiatry* 54: 572–575, 1991

- 11) Arishima H, Arai H, Kodera T, Kitai R, Kikuta KI, Takeuchi H: A large endodermal cyst with xanthogranuloma at the frontal skull base, slowly recurring with hemorrhage. *NMC Case Rep J* 3: 39–43, 2016
- 12) Chakraborty S, Priamo F, Loven T, Li J, Insinga S, Schulder M: Supratentorial neurenteric cysts: case series and review of pathology, imaging, and clinical management. *World Neurosurg* 85: 143–152, 2016
- 13) Graziani N, Dufour H, Figarella-Branger D, Donnet A, Bouillot P, Grisoli F: Do the suprasellar neurenteric cyst, the Rathke cleft cyst and the colloid cyst constitute a same entity? *Acta Neurochir (Wien)* 133: 174–180, 1995
- 14) Cheng JS, Cusick JF, Ho KC, Ulmer JL: Lateral supratentorial endodermal cyst: case report and review of literature. *Neurosurgery* 51: 493–499, discussion 9, 2002
- 15) Neckrysh S, Valyi-Nagy T, Charbel FT: Neuroenteric cyst of the anterior cranial fossa: case report and review of the literature. *Surgical Neurol* 65: 174–177; discussion 7, 2006
- 16) Kawabata M, Miyashita K, Kurono Y: The clinical characteristics of orbital complications of sinusitis and paranasal cyst. *J Jpn Soc Head Neck Surg* 29: 267–272, 2019

---

Corresponding author: Katsumi Sakata, MD  
Department of Neurosurgery, Yokohama City University Medical Center, 4-57 Urafunecho, Minami-ku, Yokohama, Kanagawa 232-0024, Japan.  
*e-mail*: ksakata@med.yokohama-cu.ac.jp