WASHINGTON – Top congressional Republicans increased pressure on President Barack Obama not to take steps on his own on immigration, telling him in their first face-to-face meeting since the GOP’s big wins on Election Day that such a move would impede their ability to work together.

At a White House luncheon with 13 leaders from both parties, Republicans intensified Thursday’s warning from House Speaker John Boehner (R-OH) that such a move by Mr. Obama would derail Republicans’ efforts to pass their own immigration legislation and destroy bipartisan cooperation on other issues.

“There was a lot of push-back from our guys. It would make not only passage of immigration reform more difficult but would also spill over to other areas of the agenda,” Senate Republican Conference Chairman John Thune (R-SD) said in an interview after the meeting.

“You have a political dynamic to actually getting some things done. If we get in a protracted fight over the use of executive orders, it really poisons the well at a time when we should be spending time on some legislative accomplishments,” he said.

Mr. Obama told the lawmakers that he had already been patient waiting for the GOP-controlled House to act since the Senate passed a sweeping bipartisan immigration bill in June 2013.

At that point, Vice President Joe Biden asked how long Republicans might need to bring up an immigration bill, according to multiple people familiar with the meeting, asking if they might be ready by mid-February or another time this spring. Mr. Obama gave him a look that ended that line of discussion, the people said.

Democratic congressional aides said the president wasn’t cutting off Mr. Biden, who was making a rhetorical point that Republicans refused to commit to bringing an immigration bill to the floor by a specific time.

Both Mr. Boehner and Sen. Mitch McConnell (R-KY), who is expected to become the chamber’s majority leader, said separately this week that they hope to work with Mr. Obama to find areas where they can work together, including overhauling the tax code and promoting trade agreements.

In Friday’s meeting, lawmakers didn’t address specifically which policies would be derailed if Mr. Obama presses ahead with his immigration plans, according to aides from both parties.

Mr. Obama vowed in his Wednesday postelection news conference to move ahead on immigration by himself, making changes that people close to the process say could give safe harbor to perhaps a few million people in the U.S. illegally.
Sen. John Barrasso (R-WY) said the meeting suggested that Mr. Obama hasn’t yet internalized the sweeping GOP wins, particularly in regard to the potential for executive actions to address immigration law.

“Nobody was running a campaign saying we think President Obama should do more executive actions. At least nobody who won,” Mr. Barrasso said after the meeting. Any effort by the White House to move on its own on immigration will “be toxic on anything everything the president wants done.”

Democrats defended the president’s ability to move on his own on immigration, saying presidents from both parties have done the same.

“The president has the authority to act by executive order on immigration,” House Minority Leader Nancy Pelosi (D-CA) told reporters as she returned to the Capitol after the meeting. She dismissed Republicans’ requests for more time to work on their own approach to overhauling immigration laws.

“They are saying, ‘Give us a chance to pass a bill.’ Well, we could take up the Senate bill next week,” Mrs. Pelosi said.

House Republicans have balked at considering the Senate bill, which would enable some illegal immigrants living in the U.S. to become citizens, and have said for months they would prefer to take a piecemeal approach, starting with toughening security at the Southern border.

White House press secretary Josh Earnest on Friday said the president wasn’t considering further delaying his executive action on immigration. Mr. Obama had opted not to make a contentious move before this week’s midterm election to preserve chances of retaining the Democrats’ Senate majority.

“The simple question before the White House and before the president himself is: Is the president going to use the authority that he has under the law and under the Constitution to take some steps that’d be good for the American people? And the simple answer to the question is yes,” Mr. Earnest said. “That’s what he’s going to do, and he’s going to do it before the end of the year.”

Congressional leaders were also briefed on national-security challenges, including the effort to combat Islamic State militants in Iraq and Syria, and the Ebola outbreak. This week, the White House has sent separate requests for additional funding to tackle each problem. Lawmakers return to Washington next week for the first time since the midterm election.

–Siobhan Hughes and Colleen McCain Nelson contributed to this article.